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FISCAL SUSTAINABILITY OF THE VISEGRAD GROUP COUNTRIES IN THE AFTERMATH OF GLOBAL ECONOMIC CRISIS

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The article investigates the sustainability of fiscal policies of the Visegrad Group countries (Poland, Czech Republic, Hungary and Slovakia) in the years 1996-2015 using statistical and econometric analysis methods. Special attention is given to the identification of subperiods of low sustainability within the framework of the Markov switching cointegration model. The results of the research show that the global economic crisis had little effect on the fiscal stance of the analysed countries, because their expansionary, countercyclical fiscal policies were promptly replaced by more restrictive policies. However, further improvements in fiscal discipline are needed to ensure sufficient space for fiscal reaction in the future.

Keywords: fiscal policy, fiscal sustainability, Visegrad Group, economic crisis, Markov switching cointegration.

JEL classification codes: E 62, H 63.

1. Introduction

Fiscal policy is one of the most popular tools for stimulating economic growth. It is also frequently used to adjust market mechanisms in a way that allows the government to accomplish its economic and social goals. The present-day economic practice is predominantly based on the theories of the Keynesian school, including the welfare state concept that recommends stabilizing market processes and securing the quality of citizens' lives, at least at the basic level, through the coordination and financing of the health, pension and social assistance systems. High costs of these solutions lead, however, to deficit financing and accumulation of debt. Excessive fiscal intervention erodes the foundations of further economic growth by weakening private sector's activity and reducing the possibilities of raising capital that the sector needs to finance its ventures. A high level of debt in the economy may also have an adverse impact on

the solvency of the State, leading to a deep crisis and recession, or even to its bankruptcy. These concerns should be given special attention during an economic crisis when most stimulation programs intended to minimize the negative consequences of economic downturn are built around an expansionary fiscal policy.

The concept of fiscal sustainability seeks to define the optimal level of public debt at which fiscal policy can accomplish its goals with a minimum negative impact on the economy. The aim of this article is to assess risks involved in the increasing use of deficit financing and public debt accumulation in the Visegrad Group countries from the perspective of fiscal sustainability.

The article consists of six parts. In part two, the definition and theoretical basis of fiscal sustainability are presented. Part three discusses sustainability indicators and tests that are afterwards used in the empirical research. In part four, fiscal sustainability of the Visegrad Group countries is tested empirically using selected statistical methods and econometric tests. The empirical analysis of the Visegrad Group countries – the Czech Republic, Hungary, Poland and Slovakia – spanned the years 1996 through 2015**.** Part five provides an insight into the policy implications of the research results. The last part concludes.

2. Fiscal sustainability – theoretical aspects

The concept of fiscal sustainability presents it briefly as efforts undertaken to keep the size of public debt within reasonable limits. The term "reasonable" means here that public debt and budget deficit need to have a minimum negative effect on the economy, while efficiently stabilizing its performance over the business cycle. Definitions of fiscal stability in this vein have been proposed, *inter alia*, by Buiter (2004, p. 4), Uctum and Wickens (2000, p. 197), and Marchewka-Bartkowiak (2008, p. 55). An operational

definition of fiscal sustainability has been put forward by Blanchard, Choraqui, Hagemann, and Sartor (1990, p. 11) and Blanchard (1990, p. 13). It states that if fiscal policy could be reduced to a process generating public debt, the sustainable fiscal policy would be one bringing the public debt/GDP ratio back to its initial level. In other words, in the long run the real government debt should not grow faster than the interest rate and the debt/GDP ratio should be kept smaller than the difference between the rate of economic growth and the interest rate. This definition highlights the fact that while fiscal sustainability does not reject the use of expansive fiscal policy, it calls for actions stabilising or reducing the debt/GDP ratio to balance the fiscal situation after a period of increased spending. The primary objective of fiscal sustainability is therefore to prevent an explosive growth of debt, which is one of the main factors responsible for the destabilisation of an economy.

A discussion of the theoretical aspects of fiscal sustainability should begin with the presentation of the concept of dynamic government budget constraint, i.e. an equation describing how differences between total government expenditures and revenues expand public debt:

$$b_s = g_s + h_s - t_s + \big(1 + (r - \theta)\big)b_{s-1} = d_s + \big(1 + (r - \theta)\big)b_{s-1}, \qquad (1)$$

where: b_s, g_s, h_s, t_s – the ratios between the real value of debt / government spending / transfers / taxes and the level of GDP in period *s*,

r – the real ex-post interest rate (the nominal interest rate minus the rate of inflation),

θ – the real GDP growth rate,

d_s – the ratio of the real value of the primary budget balance to GDP in period *s*, where $d_s = g_s + h_s - t_s$.

Following the works by Fischer (1989) and Blanchard et al. (1990), this equation can be rewritten into the intertemporal budget constraint:

$$b_n = b_0 e^{(r-\theta)n} + \int_0^n d_s \, e^{(r-\theta)(n-s)} ds. \quad (2)$$

according to which the ratio between the current value of debt and GDP is equal to the sum of the ratio's initial value and primary deficits (in relation to GDP) accumulated over the analysed period, increased by the amount of interests that grows at the same rate as the difference between the real interest rate and the real GDP growth rate (Blanchard et al., 1990, p. 11). The budget constraint equation alone does not contain restrictions that could prevent public debt from growing too much (Romer, 2006, p. 561). To handle threats arising from irresponsible fiscal policy, the concept of fiscal sustainability has been formulated, according to which the State's fiscal policy is sustainable when it can maintain the initial level of debt / GDP ratio in the long term (Blanchard et al., 1990, p. 11).

To make sure that the budget constraint equation accounts for the sustainability of fiscal policy, the so-called transversality condition must be added. It prevents the government from rolling debt over indefinitely, and from building public finances on the financial pyramid scheme (the so-called Ponzi scheme). According to the transversality condition, when *n* tends to infinity the discounted value of debt must tend to zero. This is tantamount to assuming that the value of debt/GDP ratio tends to its initial value of b_0 (Blanchard et al., 1990, p. 12; Uctum & Wickens, 2000, p. 201):

$$\lim_{n\to\infty} b_0 e^{-(r-\theta)n} = 0. \quad (3)$$

Substituting this condition into equation (2), we get the government budget constraint that makes fiscal policy sustainable over an infinite time horizon:

$$-b_0 = \int_0^{\infty} d_s \, e^{-(r-\theta)s} ds. \quad (4)$$

Equation 4 implies that fiscal policy can be deemed sustainable, if "the present discounted value of the ratio of primary deficits to GDP is equal to the negative of current level of debt to GDP" (Blanchard et al., 1990, p. 12). When both sides of the equation are multiplied by -1 the interpretation is slightly different – fiscal policy is sustainable if the present value of all projected surpluses in the primary balance is equal to the value of public debt in the initial period (Blanchard, 1990, p. 13). This means that a country with fiscal policy based on deficit financing must also think about ways of acquiring surpluses so that its debt could be repaid. When the current policy falls short of the stability criterion, a discretionary change restoring stability can be made. These conditions can be satisfied even if the process of debt generation is structurally unstable (Uctum & Wickens, 2000, p. 202).

From the analysis of equations (3) and (4) we conclude that the transversality condition does not imply that the government must follow a policy scenario zeroing the value of the debt/GDP ratio, in which case public debt would be completely eliminated as a source for financing budget deficits. It is only required that the rate of growth of the debt/GDP ratio be lower than the discounting factor $r - \theta$ (Uctum & Wickens, 2000, p. 200).

For a finite time horizon, a slightly different definition of fiscal sustainability and sustainability conditions can be adopted. In this case, fiscal policy can be regarded as sustainable if it allows the debt/GDP ratio to be maintained at some target level. Then the intertemporal budgetary constraint is the following:

$$b_0 - b_n^* e^{-(r-\theta)n} = -\int_0^n d_s \, e^{-(r-\theta)s} ds, \quad (5)$$

where: b_n^* – the target level of debt to be achieved at the end of the analysed period.

According to this equation, the expected change in the debt/GDP ratio should be equal to the discounted value of the ratio between fiscal surpluses generated during that period and GDP. The fulfilment of this equation points to sustainability of fiscal policy in the analysed period; otherwise, either the target level of the debt/GDP ratio or the fiscal policy itself need to be changed (Uctum & Wickens, 2000, p. 205).

3. Methods of fiscal sustainability assessment

3.1.Sustainability indicators

With the development of the concept of fiscal sustainability, a need arose to create tools with which the fiscal position of a country could be analysed taking account of the likely hazards, as well as allowing the most appropriate development policies to be designed. To meet the need, synthetic and easy-to-interpret indicators have been constructed. Let us note, however, that many of them omit the formal conditions set out in the previous section, using instead an intuitive understanding of the relationships and mechanisms described by the concept of fiscal sustainability (Blanchard, 1990, p. 8; Chalk & Hemming, 2000, p. 67).

The most important and frequently used indicators have been proposed by O.J. Blanchard (1990, p. 14), who found it advisable to calculate the primary gap in order to obtain basic information about the sustainability of public finance:

$$\bar{d} - d_s = (\theta_s - r_s)b_s - d_s, \tag{6}$$

where: $\bar{d}$ – primary deficit ensuring stability of the debt/GDP ratio. The indicator given by equation 6 shows the adjustment of the debt/GDP ratio in a given year. Its negative values show that the actual budget deficit is too large for the sustainability conditions to be met. This said, we need to bear in mind that the indicator disregards the possible

future effects of the current fiscal policy or the residuals of earlier measures that will materialise with a lag (Blanchard, 1990, p. 14).

Being aware of the deficiencies of the primary gap indicator, Blanchard et al. (1990, p. 12-13) came up with a concept of a sustainable tax rate and a tax gap indicator. With the condition defined by equation (4) and the data on government expenditures and transfer payments, it is possible to find a tax rate ensuring fiscal sustainability, i.e. to solve equation (4) for a fixed value of t_s marked with t^*. A positive difference between the rate of t^* and the present tax rate t_s, known as the tax gap indicator, shows the amount by which the tax rate needs to be adjusted for the fiscal sustainability conditions to be met. A common practice is to test the tax gap in the short, medium and long term (Blanchard et al., 1990, have proposed to build indicators for the current period, 3 years and 30 years).

The short-term tax gap indicator given by the following formula:

$$t_0^* - t_s = g_s + h_s - t_s + (r_s - \theta_s)b_s = d_s + (r_s - \theta_s)b_s, \tag{7}$$

amounts to the primary gap indicator. The medium- and long-term indicators can be calculated as follows (Blanchard, 1990, p. 14-15; Blanchard et. al., 1990, p. 15-16):

$$t_n^* - t_s = \frac{\sum_{j=0}^{n} g_{s-j} + h_{s-j}}{n} + (r_s - \theta_s)b_s - t_s, \tag{8}$$

The indicators built on the tax gap concept are much more reliable than the primary gap ratio. Even so, they are not free of some deficiencies, such as the arbitrary selection of the time horizon and of the fiscal target to be achieved at the end of it. The fiscal target problem is particularly vital in countries with relatively sound public finances and low levels of public debt. In this case, a slight increase in the debt/GDP ratio does not necessarily have to mean that the fiscal sustainability conditions have been breached, as

it may naturally follow from changes in the economic system that pose no risk to the fiscal sustainability of the State. Moreover, although the tax gap indicators tell us about how severe stability threats can be in the analysed period, they do not specify when they are likely to occur (Balassone & Franco, 2000, p. 44; Chalk & Hemming, 2000, p. 69).

3.2.Econometric tests

Fiscal sustainability indicators contain limited information on the country's fiscal stance and are often determined by subjective criteria adjusted to the scope of research. Because the econometric tests of fiscal sustainability are more objective, they are frequently employed to verify empirically the theory. Since we have already shown that the so-called transversality condition (3) is a prerequisite of fiscal stability, most tests are developed to see if it is met in practice.

The first fiscal stability tests created by Hamilton and Flavin (1986) and Wilcox (1989) investigated the stationarity of the public debt time series. They were criticized because their assumptions were considered overly restrictive.

As the time series methods developed, a more general approach taking advantage of cointegration testing was proposed. Having analysed the debt-accumulation equation:

$$\Delta B_s = rB_{s-1} - S_s, \tag{9}$$

Trehan and Walsh (1991, p. 209-212) concluded that for constant (stationary) real interest rates, the transversality condition is satisfied when the process generating budget surpluses diminished by interest payments is integrated of finished order. Therefore, the time series S_s and B_{s-1} have to be a stationary linear combination. In other words, if the S_s series is stationary B_s should also be stationary, but when S_s is

non-stationary, a positive cointegrating relationship should exist between the S_s and B_{s-1} series. Rejecting the assumption about constant real interest rates, Trehan and Walsh found that the stationarity of the first differences of public debt was a condition for fiscal sustainability. Overall, a fiscal policy is "strongly sustainable" when $B,S\sim I(0)$ or $B,S\sim CI$ with a cointegrating vector $[1;\eta]$, where $\eta < 0$, or "weakly sustainable" for $\Delta B\sim I(0)$.

Hakkio and Rush (1991, p. 434-435) designed a similar test. Assuming that interest rates are stationary, we can rewrite the intertemporal government budget constraint as follows:

$$Rev_s = \alpha + Exp_s + \lim_{n\to\infty} \frac{B_{s+n}}{(1+r_s)^n} + \varepsilon_s, \tag{10}$$

where: Exp_s – total government expenditures (including debt service) in period *s*,

Rev_s – total government revenues in period *s*.

When fiscal policy is sustainable, $\lim_{n\to\infty} \frac{B_{s+n}}{(1+r_s)^n} = 0$, equation (10) easily translates into the following regression equation:

$$Rev_s = \alpha + \beta Exp_s + \varepsilon_s. \tag{11}$$

According to Hakkio and Rush (1991, p. 432), cointegration of the time series of government revenues and expenditures is a prerequisite of fiscal sustainability in a setting defined by equation (11). They also posit that the cointegrating vector is given by $[1;-1]$, i.e. $\beta = 1$. This assumption is widely debated in the literature. Some economists consider it over-restrictive in the context of the transversality condition given by equation (3) (de Castro & de Cos 2000, p. 145-147). They propose instead to limit the scope of empirical tests to the examination of cointegration of the above time series. The rationale is that for $\beta \in (0;1)$ the discounted value of debt still tends towards

zero when n goes to infinity.

Hakkio and Rush argue, however, that in this case the value of non-discounted public debt grows exponentially over an infinite time-horizon, increasing the likelihood of the emergence of debt service problems as well as raising the probability of the government announcing bankruptcy at some point of time. (Hakkio & Rush, 1991, p. 433). It is also noteworthy that the public and creditors tend to assess fiscal sustainability over a time horizon corresponding to the expected lifetime or even the maturity of debt securities issued by the State. This tendency may lead to the underestimation of the long-run effects of debt reduction that result from its discounting. It is important to note that the problem of excessive debt accumulation and of rising costs of debt service can also be caused by factors other than purely economic, such as shocks of political or social nature. In such cases, the financial market's falling confidence can bring about a sudden and substantial increase in interest rates, which is more likely when the discounting factor is the only instrument that a country uses to maintain fiscal sustainability. This can lead to debt-servicing problems and the shrinking of the economy.

In the context of the aforementioned arguments, researchers have reached a consensus according to which countries are either characterised by „strong sustainability" ($\beta = 1$) or by "weak sustainability" ($\beta \epsilon (0; 1)$). When $\beta < 1$ fiscal policy is unsustainable regardless of whether a cointegrating relationship does or does not exist (Quintos,1995).

In the Trehan and Walsh test and the Hakkio and Rush test, stationarity analysis is based on the ADF or Phillips-Perron tests (Uctum & Wickens, 2000, 210). The estimates of the cointegrating vector are obtained from the two-step Engle-Granger method. The procedure can make the sustainability tests somewhat less reliable, though,

due to the well-documented problem of over-rejection of non-stationary null hypothesis in the case of unit root tests with small samples (Balke & Fomby, 1991).

Bohn (2007) has proved mathematically that under the transversality condition given by equation (3) every fiscal policy ensuring cointegration between the time series of public debt and government deficit is sustainable, regardless of their order of integration. Based on that, he proposed focusing on the analysis of the so-called „fiscal reaction function" given as:

$$s_s = \alpha + \rho b_s + \varepsilon_s, \tag{12}$$

and leaving the question of cointegration aside. According to his proposal, fiscal policy is sustainable as long as parameter ρ is positive and statistically significant. Although theoretically correct and overwhelmingly popular in recent empirical research, this methodology has some potential pitfalls that may lead to questionable results (see e.g. Mackiewicz, 2010, p. 135), which confirms that the pure transversality condition is too weak a restriction for the purposes of the empirical assessment of fiscal sustainability. Hence, many researchers still hold that cointegration is a necessary condition for the stability of public finances (Gabriel & Sangduan, 2010).

Another major issue is the structural invariance of the test model parameters. Because fiscal policy occasionally undergoes structural changes, there may be breaks in the data generating processes, which are responsible for the development of variables interesting from the fiscal sustainability perspective. Structural changes are a natural consequence of political cycles determined by election dates and of stabilisation programmes introduced to improve the fiscal stance. All these factors may bias the evaluation of fiscal policy based on a traditional unit root and cointegration tests. To

confirm that the tests' results are accurate, additional tests of the structural stability of the obtained models are proposed.

A cointegrating regression can be tested for stability using the Gregory-Hansen test, the Hansen test, the Hansen-Johansen test, and the Hatemi-J test. The most popular and most powerful of them is the Gregory-Hansen test developed on the observation that when the cointegrating vector changes in the sample period the ADF and Phillips-Perron tests are frequently unable to reject a null hypothesis about a lack of cointegration between the time series. In this case, it is advisable to test the null hypothesis of no cointegration against an alternative hypothesis stating that there is a cointegrating relationship that undergoes structural change. The test statistic is calculated separately for the three possible types of structural change using an appropriate cointegrating regression model. The possibility of a level shift being present in the cointegrating equation is tested with the following model:

$$y_{1s} = \mu_1 + \mu_2 \varphi_{i\tau} + \pi y_{2s} + e_s, \tag{13}$$

where: $\varphi_{i\tau}$ - dummy variable adopting values: $\varphi_{i\tau} = \begin{cases} 0 \text{ for } s \leq \lfloor \tau S \rfloor \\ 1 \text{ for } s > \lfloor \tau S \rfloor \end{cases}$, $\tau \in (0;1)$, and

$\lfloor \blacksquare \rfloor$ - the *entier* function,

y_{2s} – the vector of explanatory variables,

e_s – the I(0) error term.

For the level shift with a trend, the model is $y_{1s} = \mu_1 + \mu_2 \varphi_{i\tau} + \alpha_1 t + \alpha_2 t \varphi_{i\tau} + \pi y_{2s} + e_s$, and for the regime shift $y_{1s} = \mu_1 + \mu_2 \varphi_{i\tau} + \alpha_1 t + \alpha_2 t \varphi_{i\tau} + \pi_1 y_{2s} + \pi_2 y_{2s} \varphi_{i\tau} + e_s$. The functional form of the model established, the recursive OLS estimation is performed for each $[\tau S]$. In the next step, the estimates are used to calculate the ADF and Phillips-Perron statistics. The lowest of them are compared with the critical values presented by Gregory and Hansen (1996a, 1996b). To make sure that the number of the

degrees of freedom is consistently adequate, calculations should be performed for $\tau \in [0.15; 0.85]$ (Gregory & Hansen 1996b, p. 556-559; de Castro & de Cos, 2000, p. 161-162). The direct extension of the Gregory-Hansen method for two shifts during the sample period is the Hatemi-J test (2008).

The proposed tests of stability of cointegrating regression have one major drawback in common – they are based on the assumption that the number of structural breaks is determined exogenously and relatively low (between 1 and 2). Therefore, they are not a perfect tool for analysing fiscal policies the nature of which may change frequently because of political events, business cycle fluctuations, institutional developments or even changes in the expectations of private agents induced by future policy announcements (e.g. when the announcements appear to be sufficient for the fulfilment of the intertemporal budget constraint). In addition to variations in the character of the cointegrating relationship, the volatility of the analysed time series may change too, influencing the variance of the underlying processes.

In the above context, fiscal policy might be perceived as a random process with two possible states of an economy representing different fiscal regimes characterised, respectively, by fiscal sustainability and fiscal unsustainability. A state of an economy in a given period depends on a set of political, economic, technological and institutional factors. Permanent or transitory shocks to these factors that bring about sufficiently large or abrupt changes in economic performance cause an economy to move between fiscal regimes. To account for this, the variable describing the state of an economy is obtained from a process driven by independent shocks affecting the economy with some non-zero probability. The process solely depends on the current state of an economy, so it meets so-called Markov condition. As a result, the Markov process can be used to model transmission between the regimes and trace changes in the cointegrating

regressions describing fiscal policy. A formal test of fiscal sustainability based on the Markov-switching cointegration approach has been proposed by Gabriel and Sangduan (2011).

Following Hakkio and Rush (1991), Gabriel and Sangduan (2011, p. 379) proposed assessing fiscal sustainability by examining the relationship between government expenditures and revenues given by equation (11). To obtain a model with varying parameters, they used the Markov-switching approach and estimated the equation:

$$Rev_s = (\alpha_1 + \alpha_2\delta_s) + (\beta_1 + \beta_2\delta_s)Exp_s + (\omega_1 + \omega_2\delta_s)e_s. \quad (14)$$

where: e_s is an *I(0)* error term and δ_s is a discrete, latent state variable following an irreducible, aperiodic and ergodic Markov chain. The chain is assumed to be time-homogeneous with the state space of $\{1,2\}$ and transition probabilities $p = Pr(\delta_s = 1|\delta_{s-1} = 1)$, $q = Pr(\delta_s = 2|\delta_{s-1} = 2)$. Consequently, the cointegrating vector has two regimes governed by the δ_s process with the following parameters $\{(\alpha_1, \beta_1, \omega_1), (\alpha_2, \beta_2, \omega_2)\}$. This makes the model capable of differentiating between periods when the fiscal policy in an economy moving recursively between these two states was relatively sustainable and unsustainable. It is also assumed that processes may have different variance between states, $\omega_{\delta_s} = \{\omega_1, \omega_2\}$. Due to this, the model can capture potentially low and high volatility regimes. In the proposed framework, unsustainability is induced by shocks hitting an economy, so it is fully justified to expect that the unsustainable state is more volatile than the sustainable one. Equation (14) is estimated using the maximum likelihood method (Hamilton, 1994).

With the proposed formulation of the cointegrating regression, we can obtain series of standardised residuals that can be tested for the order of integration using conventional approaches. The residuals are calculated as:

$$e_s = \frac{Rev_s - (\widehat{\alpha_1} + \widehat{\beta_1} Exp_s)\Pr(\delta_s=1|I_s) - (\widehat{\alpha_2} + \widehat{\beta_2} Exp_s)\Pr(\delta_s=2|I_s)}{\left[\widehat{\omega_1^2}\Pr(\delta_s=1|I_s) + \widehat{\omega_2^2}\Pr(\delta_s=2|I_s)\right]^{\frac{1}{2}}}, \quad (15)$$

where $Pr(\delta_s = i|I_s), i = \{1,2\}$, are the filter probabilities of the Markov switching process. This procedure follows closely that proposed by Gabriel, Psaradakis, and Sola (2002), who have shown that the asymptotic distributions of traditional test statistics offer good approximations of the actual ones when the standardised residuals are used, and do not cause size distortions when the hypotheses are tested against standard critical values.

The test proposed by Gabriel and Sangduan (2011) is a generalisation of the concepts developed by Gregory and Hansen (1996a, 1996b) and Hatemi-J (2008) for the case of cointegration with multiple structural breaks. Its strength derives from the fact that the number of regime switches is not predetermined. At the same time, the test provides for only two states of nature that are characterised by sustainable and unsustainable fiscal policy, respectively. Accordingly, it is assumed that each episode of fiscal unsustainability is similar to the previous one in volatility and magnitude. Some may perceive this as a rather excessive simplification that can lessen the analytical significance of the results, especially when the degree of unsustainability is considered.

4. Analysis of the fiscal sustainability of the Visegrad Group countries in the years 1996-2015

Having presented the econometric tests and statistical indicators of fiscal sustainability,

we can now proceed to the empirical testing of the theory. The first step in the assessment of fiscal sustainability of the Visegrad Group countries is statistical analysis, the findings of which will be subsequently supplemented by the results of econometric tests. In this study, all four Visegrad Group countries – the Czech Republic, Hungary, Poland and Slovakia – are examined using annual ESA 2010 data from the years 1996-2015 obtained from the Eurostat online database. Because the available annual data series is relatively short as it consists of only 20 observations, the robustness of some estimations is checked against the 2000-2015 quarterly data obtained from the same source (unseasoned using ARIMA X13 filter) to make sure that fiscal policy trends are well identified and the research results are reliable. For the lack of earlier data on interest rates, indicators based on real interest rates were only calculated for the years 2001-2015.

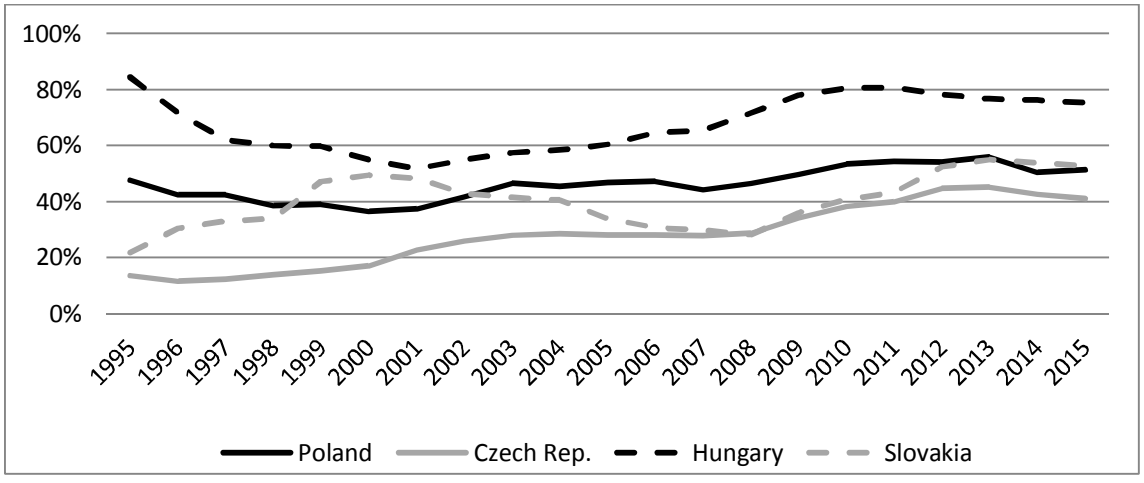
4.1. Results of statistical analysis

The beginning of the sample coincides with the end of a long economic crisis that affected the Visegrad Group countries as they were transitioning from a centrally planned to a market-based economy. Their efforts to stabilise their economies proved successful and paved the way for the next stage of systemic reforms. Poland and Hungary that in the early transition period had a relatively high ratio of public debt to GDP (49% and 85.2%, respectively; Fig.1) introduced moderately restrictive fiscal policy to heal their public finances. This allowed them to gradually reduce their budget deficits in the years 1999 and 2000 to 2.3% and 3% of GDP, respectively (Fig. 2).

Slovakia moved in the opposite direction. Its debt was initially low (22.1% of GDP), but expansionary fiscal policy conducted in the years 1996-2000 increased it by 28 percentage points. The main blame for this lies with the country's populist

governments that were reluctant to carry on with socially-costly reforms, but also, partly, with the fact that most industrial capacities of former Czechoslovakia were situated in the western part of the country, so after the independent states of Slovakia and Czech Republic emerged the latter took most of them. The result of it was high unemployment in Slovakia and bleak economic prospects. The uncertain structural situation and the repercussions of the Russian crisis of 1998 caused that the Slovakian deficit was quickly rising to reach 12% of GDP in 2000. As far as the Czech Republic is concerned, at the beginning of the analysed period the country had the lowest debt of all four countries – merely 14.6% of GDP. However, in the wake of the 1998 Russian crisis the Czechs abandoned restrictive fiscal policy and slowed down the pace of economic reforms, as a result of which the size of public debt increased considerably. Part of this increase should be attributed also to the adoption in 2003 of the ESA 95 methodology that classifies government guarantees issued to companies (formerly considered a potential liability) as part of public debt. Because all guarantees together accounted for 12% of the Czech GDP (European Commission, 2004, p. 9), public deficit kept increasing until it reached a plateau of approximately 28% of GDP.

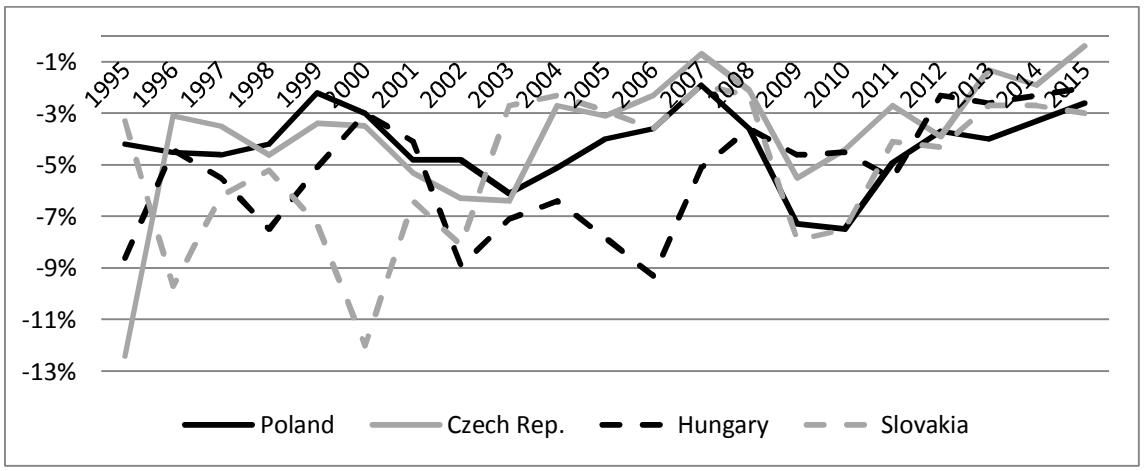
Figure 1: Consolidated general government debt in the Visegrad Group countries in 1996-2015 (% of GDP)



Source: Eurostat online database.

The years 1999-2003 were a time of economic slowdown. Expansionary fiscal policy undertaken to reverse the effects of adverse business cycle increased budget deficits in all Visegrad Group countries to as much as 6.1-8.9 percent of their GDPs. With a view to enabling economic recovery and increase the space for fiscal reaction, structural reforms were launched. The most successful was Slovakia that cut its budget deficit to the level set by the Maastricht criteria. Its high economic growth in the years 2004-2008 was accompanied by liberal reforms that considerably reduced public debt, to 27.7% of GDP in 2008. The Polish and Czech reforms proved much less effective. Issues such as inefficiencies in healthcare, pension and social security systems are still widely debated in both countries. Notwithstanding the reduction of their budget deficits in the years 2003-2007, Poland and the Czech Rep. only managed to stabilize the debt-to-GDP ratios at 47% and 29%, respectively. The worst performer in that period was Hungary. Economic slowdown increased its budget deficit to about 8% of GDP and with a lack systemic reforms preventing the reduction of debt, a debt crisis erupted in 2006. Overall, the Hungarian debt/GDP ratio rose by more than 25 percentage points.

Figure 2: General government deficits in the Visegrad Group countries in 1996-2015 (% of GDP)



Source: Eurostat online database.

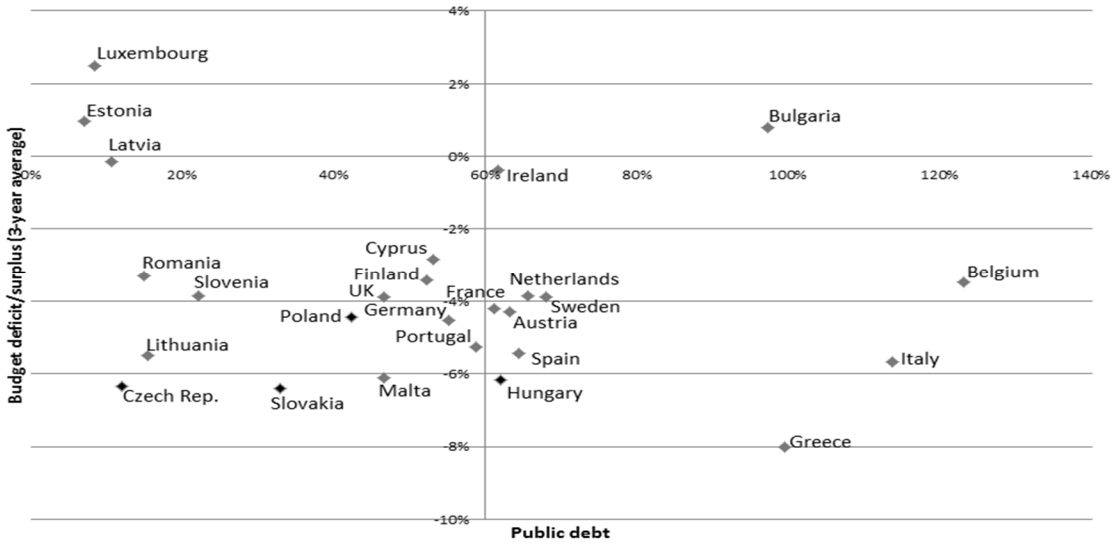
The global economic crisis in the years 2007-2009 deteriorated the fiscal positions of all four countries, resulting in substantial increases in deficit financing and

public debt levels. Government deficits caused by fiscal intervention ranged from 7.9% (Slovakia) to 5.5% of GDP (Hungary). In the aftermath of the crisis, the Slovakian debt/GDP ratio increased the most (by 25 percentage points). This seems to prove that the euro-country governments consider the Maastricht criteria to be binding as long as they seek accession to the Eurozone, but afterwards the criteria are largely ignored and fiscal discipline is relaxed. In the other three countries, fiscal expansion was more modest, resulting in debt increases of between 17 and 15 percentage points (the Czech Republic and Hungary) and 12 percentage points (Poland). After 2013, all four countries focused on stabilising public debt levels and expanding fiscal reaction space. As they tightened their budgets to meet the Maastricht criteria, the European Commission terminated the Excessive Debt Procedure that had been imposed on them before. By 2015, fiscal stabilisation allowed Poland, the Czech Rep. and Slovakia to reduce their debt-to-GDP ratios to 51.3%, 41.1% and 52.9%. By the criteria of the Stability and Growth Pact (SGP), their fiscal policy was sustainable. Hungary was the only Visegrad Group country that failed to reduce its debt/GDP ratio below the level of 60% set in the Pact (75.3% in 2015), but following the implementation of an IMF stabilisation programme it has improved the ratio by 5.5 percentage points over the last 4 years. Changes observed in the Hungary's fiscal stance seem to promise well for the future.

The medium-term performance of fiscal policies pursued by the Visegrad Group countries and other EU member states can be compared by means of graphs showing relations between debt/GDP ratios and 3-year averages of budget deficits (Fig. 3 and 4). The interpretation of the graphs is as interesting as straightforward. The axes intersect at the level of 60% of GDP, i.e. the upper limit on public debt allowed by the SGP. The countries in the fourth quadrant seem to run an immediate risk of debt crisis, because

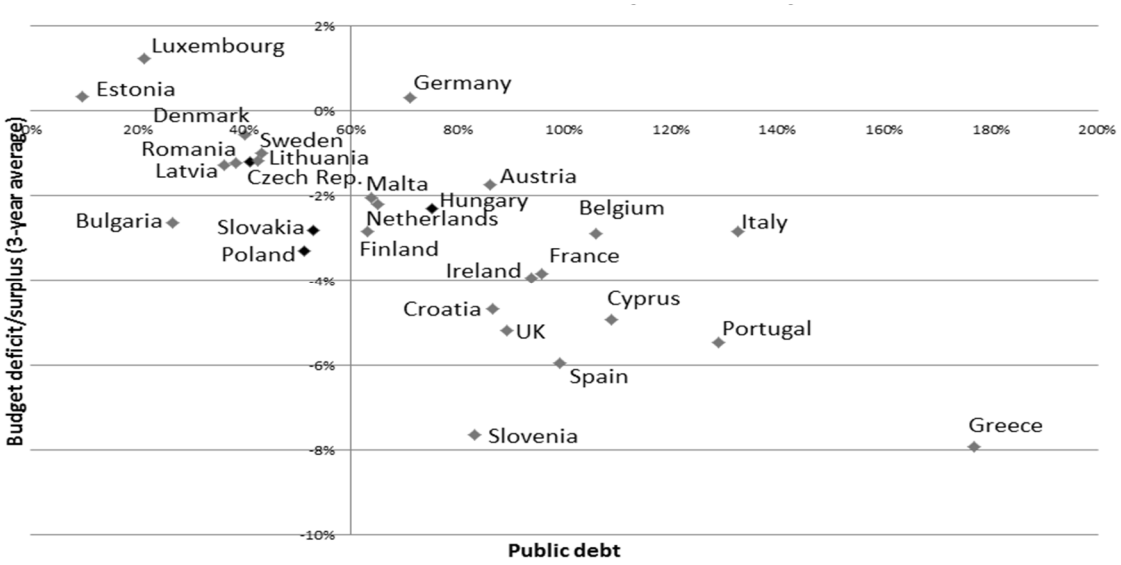
their relatively high levels of debt are repeatedly accompanied by budget deficits. The first quadrant of the graph contains countries that can be at risk should their economic outlook or the nature of fiscal policy change. Their debt levels exceed 60% of GDP, but budgetary surpluses promise that troubles can be left behind. However, a budget deficit will send them to the fourth quadrant graph where the danger of a crisis is very likely. To avert it, they should immediately undertake fiscal reforms and take advantage of the present period of prosperity to improve their situation. The countries in the third quadrant have low levels of debt and pursue expansionary fiscal policy. Although they are not at risk of a debt crisis now, the continuation of this policy in the long run may threaten their fiscal stance and they may end up in the fourth quadrant. The last, second quadrant contains countries that are safe in the medium term because of low debt/GDP ratios and fiscal surpluses ensuring stability. An analysis of how their position changed in subsequent years can provide a preliminary assessment of their fiscal sustainability in the long term. To determine the long-term trends in the fiscal policy of the Visegrad Group countries the data from years 1997 and 2015 will be compared.

Figure 3: Budget deficit/surplus and public debt levels in the European Union countries in 1997 (% of GDP)



Source: Eurostat online database.

Figure 4: Budget deficit/surplus and public debt levels in the European Union countries in 2015 (% of GDP)



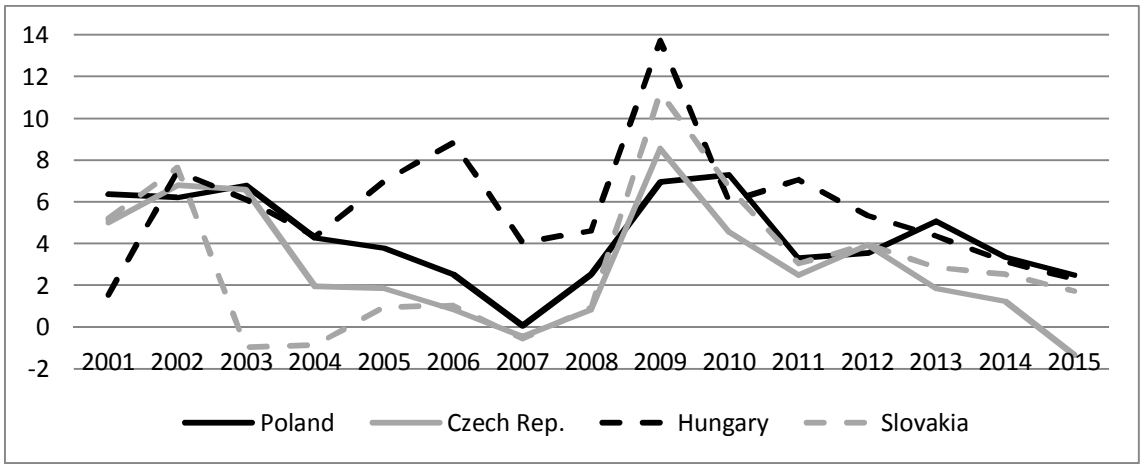
Source: Eurostat online database.

Figures 3 and 4 show that in the sample years unsustainability was increasing in actually all EU states. The number of countries at a direct risk of debt crisis (the fourth quadrant) increased from 10 in 1997 to 14 in 2015. Even the biggest and wealthiest European economies such as Germany, France, the Netherlands and UK are not safe. Hungary is the only Visegrad Group country under the threat of fiscal unsustainability. In addition to Hungarian public debt being persistently high (in both 1997 and 2015 Hungary is in the fourth quadrant of the graph), the 2006 debt crisis and global economic crunch caused that Hungary's budgetary position weakened significantly in the subsequent years The fiscal stance of the other Visegrad Group member states (Poland, the Czech Rep. and Slovakia), although not alarming from the perspective of the adopted criteria, worsened considerably in recent years mainly due to sustained deficit financing increasing their debt/GDP ratios. These unfavourable developments moved these three countries hazardously close to the maximum allowable debt-to-GDP ratio of 60%.

Because the primary gap indicator makes it possible to compare the actual budget deficit with a budget deficit assuring the stabilisation of the debt/GDP ratio in a

given year, it can be used for assessing short-term fiscal sustainability. Its positive values mean that fiscal contraction is needed and negative values show that the debt/GDP ratio has been diminished and the real debt growth has reached a stable level. Figure 5 shows that in the period under consideration at least two subperiods of expansive fiscal policy were present, mainly because of the negative dynamics of business cycle between 2001 and 2003 and from 2008 to 2010. The maximum values of primary gaps in these subperiods amounted to 7 and 13 percentage points, respectively. In the intervening years, fiscal contraction gradually reducing excessive deficits was observed. Hungary was the only country that failed to achieve fiscal stabilisation between 2003 and 2007. In the second period of restrictive fiscal policy that commenced in 2011, all Visegrad Group countries managed to improve their fiscal policy and significantly reduced primary gaps.

Figure 5: Primary gap indicator in the Visegrad Group countries in 2001-2015 (p.p.)



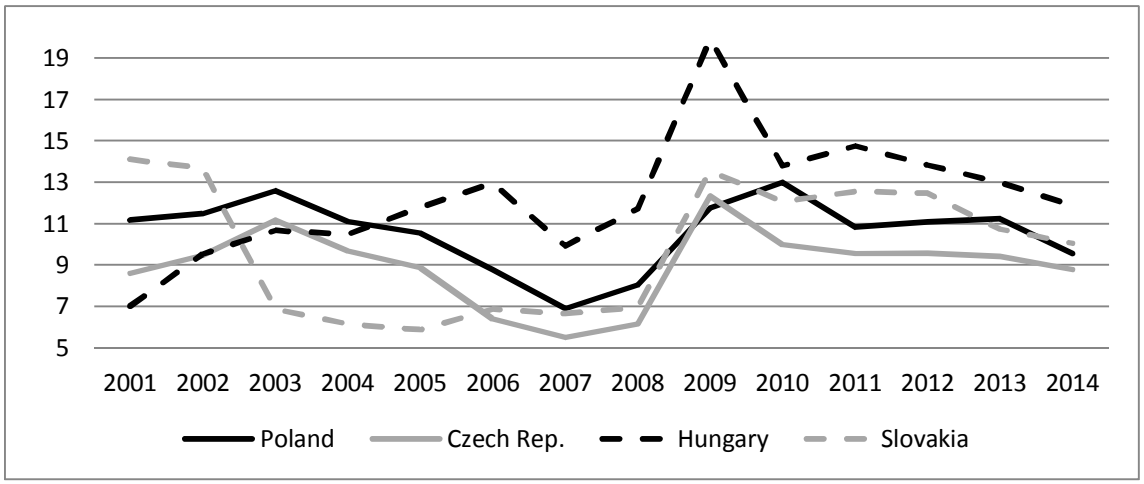
Source: Eurostat online database.

The last of the indicators proposed in section 3.1. is the index of medium-term tax gap (Figure 6). It shows the amount by which public revenues need to be increased for public debt to be stable. The results obtained with the tax gap indicator and with the primary gap indicator are basically consistent. They show that the Czech Rep. and

Slovakia still need to increase their revenues by about 10 percentage points to achieve fiscal sustainability, and Poland and Hungary by 12 percentage points.

Summing up, the results yielded by the standard statistical analysis methods do not cause much concern about the fiscal prospects of the Visegrad Group countries. Hungary is the only country that seems to be faced with fiscal sustainability problems. Poland, the Czech Republic and Slovakia are still relatively safe, but they need fiscal consolidation to expand space for fiscal reaction, which is today too narrow to enable the use of fiscal policy as a stabilising device should the business cycle took a negative turn.

Figure 6: Medium-term (3-year) tax gap indicator in the Visegrad Group countries in 2001-2014 (p.p.)



Source: calculated by the author with data from the Eurostat online database.

4.2.Results of econometric sustainability tests

In this part of the paper, the results of analysis performed using a formal econometric methodology are presented. They were obtained, as before, with the annual 1996-2015 data contained in the Eurostat online database. Because the available time series are quite short (only 20 observations), the research was faced with the problem of the small sample performance of stationarity and cointegration tests that tend to overreject null hypotheses (Balke & Fomby 1991), and with unsatisfactory small sample performance

of estimators. At the same time, though, the use of the annual data made it possible to assess fiscal policy performance in each year of the whole post-transformation period. Analysing a country's fiscal policy over an annual period is also advisable, because institutional arrangements, etc., may contribute to the seasonality of different categories of government expenses and revenues, thus temporarily affecting the country's fiscal stance. The quarterly fiscal data that were available only for the years 2000-2015 were used solely to test the robustness of our estimations.

In the first stage of econometric analysis, the method proposed by Trehan and Walsh (1991) was used. The time series of the real consolidated public debt (B_s), the real primary surpluses (S_s), and their respective differences were employed to assess the fiscal sustainability of the Visegrad Group countries. The time series were **tested** for stationarity using the ADF, ADF-GLS and KPSS unit root tests and within the confirmatory analysis scheme. The null hypothesis in the ADF and ADF-GLS tests assumes that the time series being assessed is non-stationary, and that in the KPSS test that it is stationary. The null hypothesis being supported /rejected by one of the tests and rejected/supported by the other proves that the conclusions drawn from these tests are correct. The rejection or acceptance of the null hypothesis in each of the tests means that the tests are non-conclusive. While the procedure is not very efficient (Maddala, 2008, p. 619), it offers significant benefits when short samples are considered (see e.g.: Kębłowski & Welfe, 2004). The lags for the ADF and ADF-GLS tests were selected using Hendry's "from general to specific" method, which boils down to the recursive estimation of test equations during which a large number of lags is successively reduced until only the significant estimates are left. Maddala (2008, p. 615) argues that this approach prevents the selection of excessively small lags, which is a common problem

when Akaike's (AIC) or Bayesian informative criteria (BIC) are applied. The lags for the KPSS test were selected according to the relevant criterion (Welfe, 2009, p. 368).

Table 1: Evaluation of fiscal sustainability of the Visegrad Group countries in 1995-2016 and its subperiods using Trehan and Walsh's test (1991):

Country	Time series stationarity					Cointegration	Fiscal sustainability
	B_s	S_s	ΔB_s	ΔS_s	$\Delta^2 B_s$		
1996-2015							
Poland	No	Inconcl.	**Yes**	**Yes**	-	No	Yes (Weak)
Czech Rep.	Inconcl.	Inconcl.	**Yes**	**Yes**	-	No	Yes (Weak)
Hungary	No	No	Inconcl.	Yes	**Yes**	-	No
Slovakia	Inconcl.	Inconcl.	**Yes**	**Yes**	-	No	Yes (Weak)
1996-2006							
Poland	No	Inconcl.	**Yes**	**Yes**	-	No	Yes (Weak)
Czech Rep.	No	Inconcl.	**Yes**	**Yes**	-	No	Yes (Weak)
Hungary	No	No	No	Yes	**Yes**	-	No
Slovakia	No	Yes	**Yes**	-	-	-	Yes (Weak)
2007-2015							
Poland	Inconcl.	Yes	**Yes**	-	-	-	Yes (Weak)
Czech Rep.	**Yes**	Inconcl.	-	Yes	-	-	**Yes**
Hungary	No	Inconcl.	Inconcl.	Yes	**Yes**	-	No
Slovakia	No	No	Inconcl.	Yes	**Yes**	-	No

Source: calculated by the author.

Table 1 summarizes test results obtained with the whole sample and two subperiods of 1996-2006 and 2007-2015. The first subperiod extends between the end of the transition period during which major reforms were launched and the eruption of the global financial crisis, and the second one spans the crisis and post-crisis years.

The results clearly point to Hungary as the only Visegrad Group country where fiscal policy was consistently unsustainable over the sample years (the first differences of public debt are non-stationary). The policy slightly improved after the 2006 debt crisis after the introduction of an IMF stabilisation program, but it was still far from being at least weakly sustainable (the test results change from rejecting the hypothesis about the stationarity of the first differences of public debt to being inconclusive).

In the other countries, fiscal policy that was at least weakly sustainable over the whole sample period differed between the subperiods. In the years 1996-2006 it was weakly sustainable in all three of them (in Poland also during the global financial crisis

and afterwards). The Czech Republic fully stabilised its public finances in the seven years between 2007 and 2015. Slovakia, where fiscal sustainability was relatively high in the years preceding its successful accession to the Eurozone in 2008, in the next years chose to relax the fiscal rules, as the SGP criteria were not binding anymore. As a result, its fiscal policy became unsustainable in the second subperiod.

The results of analyses performed using the method proposed by Trehan and Walsh (1991) lead to a conclusion that the Polish and Czech fiscal policies were sustainable over the sample years, unlike that pursued by Hungary. There are also serious concerns about fiscal sustainability in Slovakia, especially in the years 2007-2015.

Table 2: Cointegration analysis of the time series of public revenues and expenditures in the Visegrad Group countries obtained using the Engle-Granger method and assessment of their fiscal sustainability using Hakkio and Rush's test (1991):

Country	Sample period	β_1	AEG test *p*-value	Fiscal sustainability
Poland	1996-2015	0.902***	**0.014**	Yes(Weak)
	1996-2006	0.895***	**0.001**	Yes(Weak)
	2007-2015	0.924***	**0.001**	Yes(Weak)
Czech Rep.	1996-2015	0.970***	**0.042**	Yes(Weak)
	1996-2006	0.922***	0.580	No
	2007-2015	1.013***	0.477	No
Hungary	1996-2015[1)]	0.955***	0.523	No
	1996-2006[2)]	0.816***	0.079	No
	2007-2015	1.049***	0.235	No
Slovakia	1996-2015	0.903***[a)]	**0.048**	Yes (Weak)
	1996-2006[1)]	0.891***[a)]	0.121	No
	2007-2015	0.905***[a)]	0.210	No

AEG stands for the Augmented Engle-Granger test, i.e. the Augmented Dickey-Fuller test of residuals from the cointegrating regression.

The null hypothesis of significance of estimates is rejected at *** p <0.01, ** p <0.05, * p <0.1.

[1)] A cointegrating vector obtained assuming that the process generating budget revenues is I (1) .

[2)] A cointegrating vector obtained assuming that the processes generating expenditures and revenues are I (1).

[a)] A cointegrating relationship without a constant.

Source: calculated by the author.

Because the fiscal stability conditions imposed by the method proposed by Hakkio and Rush (1991) are more restrictive, it can be used to test the robustness of the

earlier results. This analysis utilises the time series of real general government expenditures (Exp_s) and revenues (Rev_s) and their first differences. To test the time series stationarity, the confirmatory analysis is used. Its results are presented in detail in Table A.1, Appendix 1. The testing procedure generally confirmed that the time series under consideration were difference-stationary. In four cases the results were inconclusive, but because I(2) processes are not very common among macroeconomic time series, we attributed this to the existence of structural breaks rather than to the non-stationarity of the first differences and proceeded for now as if they were I(1). The cointegrating regression estimates used in the analysis were determined from the Engle-Granger two-step procedure. The estimates are summarised in Table 2.

When the whole sample was considered, the method proposed by Hakkio and Rush and the Trehan and Walsh procedure yielded almost identical results. They showed that three of the Visegrad Group countries (Poland, Czech Rep. and Slovakia) were weakly sustainable (the cointegrating relationship is present but it is statistically significantly different from 1) and that Hungary lacked fiscal sustainability in all years. The results for the subperiods are less clear. Meaningful estimates of the cointegrating relationships were obtained only for Poland. They show that Poland slightly tightened its fiscal policy after 2007, but not enough to restore fiscal sustainability. For the other countries, cointegrating relationships that make residuals stationary were not obtained. The standard interpretation of the subperiod results points to unsustainable fiscal policy in the Czech Rep., Hungary, Slovakia, but it is challenged by the results obtained for the Czech Rep. and Slovakia over the whole sample. The situation may be due to some misspecification of the structural break data, to which the method of analysis was sensitive. To find whether it was so, the potential date of a structural break was

specified using the Gregory-Hansen test. We assumed that a structural change affects the slope of the cointegrating relationship. The results of this test are shown in Table 3.

Table 3: Results of Gregory-Hansen test of stability of cointegrating regression of public revenues and expenditures

Country	Breakpoint date	ADF statistic	Breakpoint date	PP (*Zt*) statistic
Poland	2012	**-5.86*****	2008	-3.84
Czech Rep.	2008	-4.37	2008	-4.49
Hungary	2003	**-5.36****	2004	**-5.07****
Slovakia	2007	-4.06	2007	-4.17

The null hypothesis of significance of estimates is rejected at *** p <0.01, ** p <0.05, * p <0.1.

Source: calculated by the author.

The analysis revealed that a structural break may have occurred in Poland in 2012 and in Hungary in 2003-2004. As far as Poland is concerned, the break may have been caused by the retightening of fiscal policy with a view to making the European Commission lift the Excessive Deficit Procedure. In Hungary, the probable reason was the explosion of deficit financing that precipitated the crisis in 2006. The results obtained for Poland suggest that fiscal sustainability should be tested for two subperiods of 1996-2012 and 2012-2015. As the second period is very short, it is difficult to obtain meaningful results for Poland**.** Let us therefore focus our attention on Hungary. The results of additional estimations are presented in Table 4.

Table 4: Additional assessment of Hungary's fiscal sustainability using Hakkio and Rush's test (1991):

Country	Sample period	β_1	AEG test *p*-value	Fiscal sustainability
Hungary	1996-2015[1)]	0.955***	0.523	No
	1996-2004[2)]	0.845***	0.100	No
	2004-2015	1.069***	**0.056**	**Yes**

AEG stands for the Augmented Engle-Granger test, i.e. the Augmented Dickey-Fuller test of residuals from the cointegrating regression.

The null hypothesis of significance of estimates is rejected at *** p <0.01, ** p <0.05, * p <0.1.

[1)] A cointegrating vector obtained assuming that the process generating budget revenues is I (1) .

[2)] A cointegrating vector obtained assuming that the processes generating expenditures and revenues are I (1).

Source: calculated by the author.

The results of re-estimation of the cointegrating regression are much closer to those obtained earlier from the Trehan and Walsh method. They show that in the initial period (1996 to 2004) Hungary's fiscal policy was very unsustainable. After 2004, the government efforts gradually stabilised the situation, but not sufficiently to ensure fiscal sustainability over the whole period of analysis. It needs to be noted, however, that these results are conditional on the assumption about only one structural break in the analysed period. This shows the main weakness of the Hakkio and Rush method (1991), i.e. its high sensitivity to the presence of structural breaks and the manner of specifying them. The results presented in the next paragraphs were obtained with the method proposed by Gabriel and Sangduan (2011), who improved the Hakkio and Rush (1991) framework by using Markov chains to generalise the process of specification of structural breaks. Because their method does not involve any restrictions on the total number of structural breaks in the data, the estimates of cointegrating relationships it produces are more accurate.

To ensure comparability between the results obtained with the Markov-switching cointegration models and traditional sustainability tests, the annual data on government expenditures and revenues were used again. As problems with the small sample performance of the estimators were expected, additional analysis utilizing the available quarterly data was carried out to test the estimates' robustness to changes in model specification. Estimations were based on the Markov-switching dynamic regression model (MSDR) that allows for switches in the constant, slope and variance of the analysed relationship. The initial values of unconditional probabilities were obtained from the pre-estimation of an analogous model with constant variance. Because the model was based on data in levels and our earlier research showed that the time series of public expenditures and revenues were *I(1)*, the estimates generated by

the model can be taken to represent the coefficients of the cointegrating vector. To find out if it was so, we performed, following Gabriel et al. (2002), the Augmented Engle-Granger (AEG) test, i.e. an ADF test of stationarity of standardised residuals obtained from the MSDR model. In the next step, the *t* and χ^2 statistics of the hypotheses about parameter values varying across the states were computed and, finally, fiscal performance was compared between the Visegrad Group countries.

Table 5: Estimates of Markov switching dynamic regression model of the Visegrad Group countries in 1996-2015 – annual data

Statistic type	Country	Poland	Czech Rep.	Hungary[1)]	Slovakia
State 1 estimates	const	10060.3*** (742.3)	-31483.9 (65100.7)	-753962.3*** (185020.8)	-675.9* (368.8)
	Exp_s	0.819*** (0.002)	0.924*** (0.047)	0.964*** (0.021)	0.888*** (0.030)
	Var	655.5 (57.6)	31897.1 (5767.5)	234436.6 (60108.2)	770.4 (115.9)
State 2 estimates	const	-2872.3 (4212.3)	-56641.8*** (17704.7)	-152662.1*** (35347.8)	-419.4*** (149.4)
	Exp_s	0.920*** (0.110)	1.001*** (0.016)	0.964*** (0.004)	0.950*** (0.005)
	Var	9054.6 (1580.8)	22046.5 (4770.6)	66299 (9258.7)	207.1 (39.7)
Transition probabilities	p_{11}	0.563 (0.368)	0.707 (0.175)	0.869 (0.084)	0.701 (0.141)
	p_{21}	0.102 (0.071)	0.211 (0.203)	0.075 (0.093)	0.171 (0.121)
t-tests (*p*-values)	$Exp_s \geq 1$ (State 1)	0.000	0.052	0.043	0.000
	$Exp_s \geq 1$ (State 2)	0.000	0.513	0.000	0.000
chi^2 test (*p*-value)	Var (State1) = Var (State 2)	0.000	0.199	0.000	0.000
AEG test	*t-adf*	-3.475***	-3.502***	-4.062***	-3.318**
Fiscal sustainability	State 1	Yes (weak)	Yes (weak)	Yes (weak)	Yes (weak)
	State 2	Yes (weak)	**Yes**	Yes (weak)	Yes (weak)

The null hypothesis of significance of estimates rejected at *** p <0.01, ** p <0.05, * p <0.1. Values of robust standard errors are given in parentheses.

[1)] A cointegrating vector obtained assuming that the process generating budget revenues is I (1).

Source: calculated by the author.

Table 5 provides a summary of estimates obtained with the annual data. To enable comparisons, in Table B.1 of Appendix B the estimates based on the quarterly data are also presented. The use of different sample periods causes, however, that the

yearly and quarterly estimates are not numerically comparable, so the latter were mainly used to test the robustness of general trends captured by the models.

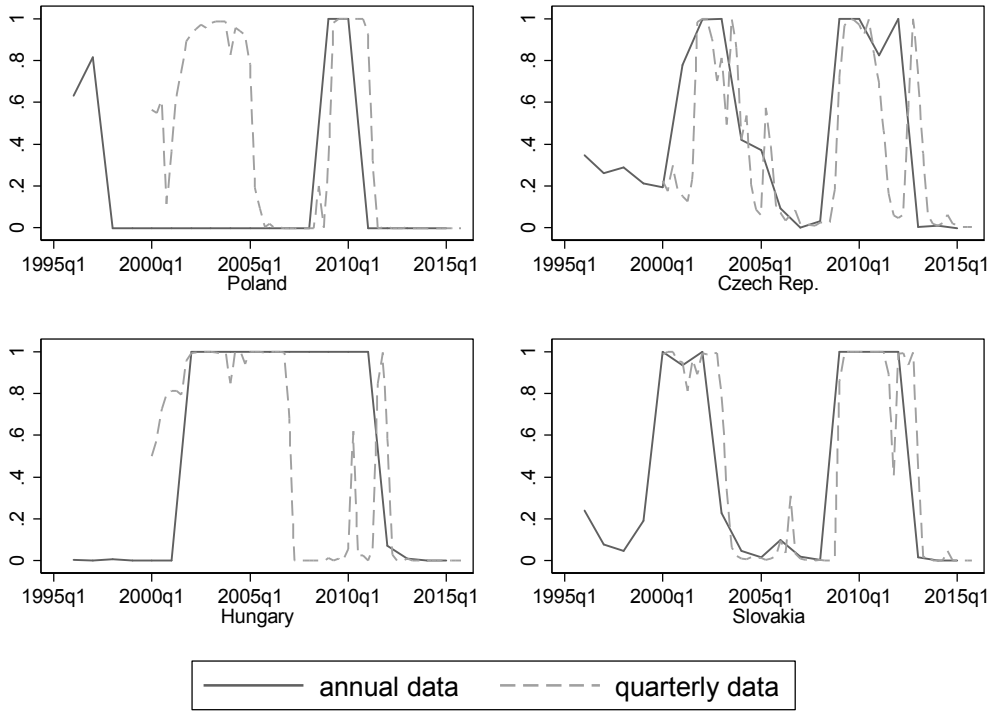
The standard (yearly) models and the aforementioned traditional tests of fiscal sustainability yielded results that are generally alike. They basically show that in all analysed countries fiscal policy was "weakly" sustainable (the AEG test revealed that each of the estimated relationships was a stationarity-inducing combination). Two regimes characterised by different fiscal policy and volatility of economic processes were identified. The first of them (State 1) involved relatively low sustainability of public finances and high volatility of economic situation. The second regime (State 2) was marked by improved solvency and low economic volatility. Some exception to this pattern was the Czech Republic, for which statistically significant differences in variance were not observed. The Czech Republic was also the only Visegrad Group country that succeeded in fully stabilising its fiscal policy. In the Czech case, the *t*-test failed to reject the hypothesis that the estimate of State 2 β parameter was equal to or higher than 1, a prerequisite of "strong" fiscal sustainability.

Because the estimation procedure used a relatively short sample consisting of only 20 observations, its outcomes may have been biased. Therefore, additional estimations based on the 2000-2015 quarterly data and a sample of 64 observations were performed. The obtained results were numerically incomparable because the lack of appropriate quarterly data resulted in different time spans of the samples, but they still could be used to assess the validity of general tendencies identified by the model and to compare the quality of the estimates.

The quarterly data model, too, identified two regimes with different fiscal policy and economic volatility. All four countries pursued fiscal policies that were at least weakly sustainable, but only the Czech fiscal policy was perceived as "strongly"

sustainable over the whole period of analysis, i.e. under both regimes. Hungary successfully achieved full stabilisation of its budgetary expenses in one of the regimes. The analysis of robust standard errors in both models were, quite naturally, slightly to the advantage of the quarterly data; however, the results of the model based on yearly data, especially the estimates of the parameters describing the amount of interdependence between the levels of budgetary revenues and expenditures, were almost equally good.

Figure 7: Filtered probabilities of appearance of MSDR model State 1 in the Visegrad Group countries in 1996-2015– a comparison of results based on the annual and quarterly data.



Source: calculated by the author.

The last question about the two models' estimates concerns their accuracy in predicting regime changes and therefore periods of potentially lower or higher sustainability of fiscal policy. It can be answered by with the use of Figure 7 that compares the filtered probabilities of State 1 occurring obtained from both models. It is easy to see that the results they yielded are almost identical. The only major difference

between them is that the annual data model failed to predict a likely deterioration of fiscal sustainability in Poland in the years 2000-2005. The models also differ slightly in their assessment of the performance of Hungary's fiscal policy from 2006 to 2009, but it is possible that the differences were caused by the inability of the low-frequency data **to** quickly reflect changes in the economy and not necessarily by the inefficiency of the small sample estimates of the models' parameters.

Based on the estimates obtained from the MSDR model it can be concluded that the Czech Republic has the best fiscal stance of all Visegrad Group countries, the finances of which were very sustainable in the years 1996-2000, 2005-2008, as well as after 2013. Two episodes of less restrictive countercyclical fiscal policy observed between 2000 and 2005 and during the last economic crisis (2008-2013) did not weaken their fiscal stance too much. As far as Poland is concerned, episodes of weakly sustainable fiscal policy were noted at the very beginning of the analysed period and in 2009-2011. In all the other years, Poland's fiscal stance, although still a far cry from being strongly sustainable, was not at risk. The situation of Slovakia and Hungary was much worse. Slovakia's fiscal policy was relatively sustainable mainly in the years preceding its entry to the Eurozone and Hungary had major fiscal sustainability problems between 2001 and 2013.

5. Policy implications

In summing up the above findings, one needs to note that the statistical analysis and the econometric analysis similarly assessed the fiscal position of the Visegrad Group countries. The fiscal policy changes in the Czech Republic and Poland moved both countries closer to fiscal sustainability and allowed them to maintain space for fiscal reaction. Considering that the present level of the debt-to-GDP ratio in the Czech Rep.

is 41% and that the average countercyclical reaction of the Visegrad Group countries during the economic crises of 2000-2003 and 2007-2010 was within 9% of their GDPs per year, that level is probably sufficient for the Czech Rep. to tackle a potential downturn in economic activity without infringing the SGP limit of 60%. Nevertheless, Poland should stick to its restrictive fiscal policy in the years to come to protect its fiscal reaction space. The feasibility of this under the present political leadership is uncertain, particularly that the budget discipline has already been seriously breached by the introduction of large-scale public spending schemes such as the Family 500+ child benefit program, free medicines for seniors and the reversal of the retirement age reform.

Slovakia was very skilful in reducing public debt during the Eurozone accession process, but after it was granted membership in 2008 and the SGP constraints were lifted it posted the highest budget deficit of all the Visegrad Group countries that significantly increased its debt/GDP ratio. Slovakia is not likely to restore fiscal stability without reversing this trend, particularly that Slovakian public debt is quickly heading for 60% of GDP. The case of Hungary is much more complex. The eruption of public discontent in 2006 forced Hungarian politicians to change fiscal policy, but with public debt as high as 80% of GDP, their efforts to stabilise the country's economy proved insufficient. Hungary still needs reforms stimulating economic development and improving its fiscal position through major changes to healthcare, social security and pension systems, but it is questionable if the present populist government will be willing to undertake them.

6. Conclusion

This article provides an empirical assessment of fiscal sustainability in the Visegrad

Group countries from 1996 through 2015. Analysis was performed using both statistical and econometric methods that yielded consistent results. The traditional methods of analysing fiscal sustainability proved vulnerable to the specification issues, e.g. the specification of structural breaks. The results of fiscal sustainability testing may differ considerably when the selected number and timing of breaks lead to highly unrealistic assumptions. This problem can be solved by employing methods that generalise and objectify the selection of structural breaks, such as the Markov switching cointegration models.

The empirical analysis has showed that none of the Visegrad countries managed to introduce a fully sustainable fiscal policy in the sample years. The Czech Republic proved the most successful in this respect. The Polish and Slovak debt/GDP ratios were still dangerously close to the 60% limit imposed on government debt by the Stability and Growth Pact. The worst situation was observed in Hungary, where healthcare and social security and pension systems are still in need of major reforms to improve the country's fiscal stance. In none of the four countries did fiscal stability deteriorate as a result of the global economic crisis, because after short periods of expansionary, countercyclical fiscal policy they quickly resorted to more restrictive policies. More fiscal improvements are, however, necessary for the Visegrad group countries to have sufficient space for fiscal reaction in the future.

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Appendix A. Results of the unit root tests:

Table A. 1: Evaluation of stationarity of the time series of general government expenditures and revenues of the Visegrad Group countries in years 1995-2016 and subperiods:

Country	Time series stationarity			
	Exp_s	Rev_s	ΔExp_s	ΔRev_s
		1996-2016		
Poland	No	No	**Yes**	**Yes**
Czech Rep.	No	No	**Yes**	**Yes**
Hungary	No	No	**Yes**	Inconcl.
Slovakia	No	No	**Yes**	**Yes**
		1996-2006		
Poland	No	No	**Yes**	**Yes**
Czech Rep.	No	No	**Yes**	**Yes**
Hungary	No	No	Inconcl.	Inconcl.
Slovakia	No	No	**Yes**	Inconcl.
		2007-2016		
Poland	Inconcl.	Inconcl.	**Yes**	**Yes**
Czech Rep.	No	No	**Yes**	**Yes**
Hungary	No	No	**Yes**	**Yes**
Slovakia	No	No	**Yes**	**Yes**

Source: calculated by the author

Appendix B. Markov-switching dynamic regression model – robustness check:

Table B.1: Estimates of Markov switching dynamic regression model of the Visegrad Group countries in 2000-2015 – quarterly data

Statistic type	Country	Poland	Czech Rep.	Hungary[1)]	Slovakia
State 1 estimates	const	18699.7*** (5021.5)	-5858.7 (33550.8)	-1124415.0*** (157844.8)	-248.6*** (90.6)
	Exp_s	0.726*** (0.039)	0.898*** (0.087)	0.523*** (0.051)	0.898*** (0.021)
	Var	2408.1 (629.6)	19739.7 (4068.9)	83789.9 (16199.2)	234.77 (22.6)
State 2 estimates	const	4397.9 (7070.5)	-66692.0*** (23202.6)	210282.2 (314849)	-42.9 (62.9)
	Exp_s	0.891*** (0.046)	1.117*** (0.061)	0.874*** (0.093)	0.940*** (0.011)
	Var	3845.1 (586.2)	11403.8 (1119.6)	114157.1 (12385.6)	125.9 (14.7)
Transition probabilities	p_{11}	0.927 (0.074)	0.838 (0.073)	0.943 (0.039)	0.942 (0.047)
	p_{21}	0.048 (0.025)	0.088 (0.043)	0.049 (0.037)	0.048 (0.030)
t-tests (*p*-values)	$Exp_s \geq 1$ (State 1)	0.000	0.118	0.000	0.000
	$Exp_s \geq 1$ (State 2)	0.009	0.973	0.088	0.000
chi^2 test (*p*-value)	Var (State1) = Var (State 2)	0.139	0.011	0.180	0.000
AEG test	*t-adf*	-4.843***	-5.778***	-5.667***	-5.352***
Fiscal sustainability	State 1	Yes (weak)	**Yes**	Yes (weak)	Yes (weak)
	State 2	Yes (weak)	**Yes**	**Yes**	Yes (weak)

The null hypothesis of significance of estimates rejected at *** p <0.01, ** p <0.05, * p <0.1. Values of robust standard errors are given in parentheses.

[1)] A cointegrating vector obtained assuming that the process generating budget revenues is I (1).

Source: calculated by the author.