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Fiscal Sustainability in the EU After the Global Crisis: Is there any Progress?

Abstract

In response to the global crisis a number of new institutional measures have been introduced in the fiscal framework, both on the UE and on the member states' level, and the question is: have these measures provided better fiscal sustainability outcomes? We approach this question by looking at the evolution of fiscal sustainability in Poland, which is an interesting case of a member state that without significant market pressure (the only EU country without recession during the crisis) actively promoted several changes in the EU fiscal framework (e.g. 6-pack) and effectively internalized some of these key changes in its domestic fiscal policy, including a domestic expenditure fiscal rule. Our analysis reveals that the fiscal sustainability in Poland has significantly improved in the post-crisis period of 2009-2017: we detect both improvement of the fiscal sustainability parameters and structural breaks in the fiscal outcomes after the crisis. Namely, in comparison to the whole sample of 2004-2017 the strength of reaction of the primary deficit to a change of the public debt increased in the post-crisis time by nearly 50%. Importantly, these results are robust with respect to the pension fund reform which led to a one-off redemption of T-bonds in amount of 8.5% of GDP. The analysis also reveals a cycle of structural breaks of 2- and 4 years lags: for the output gap in 2008 Q4, for the primary deficit in 2010 Q4 and for the public debt in 2014 Q1. The case of Poland seems to suggest that the post-crisis EU fiscal measures can be effectively used to increase fiscal sustainability, if properly approached and internalized into the domestic fiscal framework. More research should be devoted to understanding the political and economic conditions under which such positive outcomes were possible.

JEL-Codes: C220, E600, H630.

Keywords: fiscal sustainability, fiscal policy, global crisis.

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1. Introduction

Fiscal policy sustainability has always been in the center of attention of policy makers in the UE, but after the recent global financial crisis and the sovereign debt crisis in the euro area its role has increased even more. In response to the crisis a number of new institutional measures have been introduced in the fiscal framework, both on the UE and on the national level and the question is: have they provided better fiscal sustainability outcomes?

We approach this question by looking at the evolution of the fiscal sustainability in Poland, which is an interesting case of a member state that during the crisis actively promoted several changes to the EU fiscal framework (e.g. 6-pack) and effectively internalized some of these key changes in its domestic fiscal policy, including a domestic expenditure fiscal rule¹. Unlike previous studies (see for example Cizkowicz et al (2016)) we take a much closer look at the fiscal sustainability prior and after the global financial crisis. Moreover, we analyze the fiscal sustainability in the strong sense, as compared to the previous studies that analyzed weak measures of fiscal sustainability (see for example, Krajewski et al (2016), Wysocki (2017), Bökemeier, Stoian, 2016). Our analysis shows that fiscal sustainability in Poland has significantly improved in the post-crisis period of 2009-2017: we noticed both improvement of the fiscal sustainability parameters and structural breaks in the fiscal outcomes after the crisis. Namely, compared to the whole sample of 2004-2017 the strength of the reaction of the primary deficit to a change of public debt increased in the post-crisis times by nearly 50%. Importantly, these results are robust with respect to the pension fund reform which led to a one-off redemption of T-bonds in the amount of 8.5% of GDP. The analysis also reveals a cycle of structural breaks of 2-and 4 years lags: for output gap in 2008 Q4, for primary deficit in 2010 Q4 and for public debt in 2014 Q1 which led to a closure of the excessive deficit procedure in 2015 Q2. A massive social expenditure program introduced in 2017 was made possible due to the improved fiscal policy outcomes, but it may present a regime shift that should be verified in the near future.

The outline of the remainder of the paper is as follows. The next section sets the scene by presenting the main stylized facts on the fiscal public finance in Poland after EU accession and the changes implemented in response to the crisis. Section 3 presents literature on measuring the fiscal sustainability. Section 4 provides data description and estimation methods. Section 5 present results of econometric tests. Sector 6 checks the robustness of econometric results with respect to the pension fund reform implemented in 2014. Section 6 constitutes a conclusion.

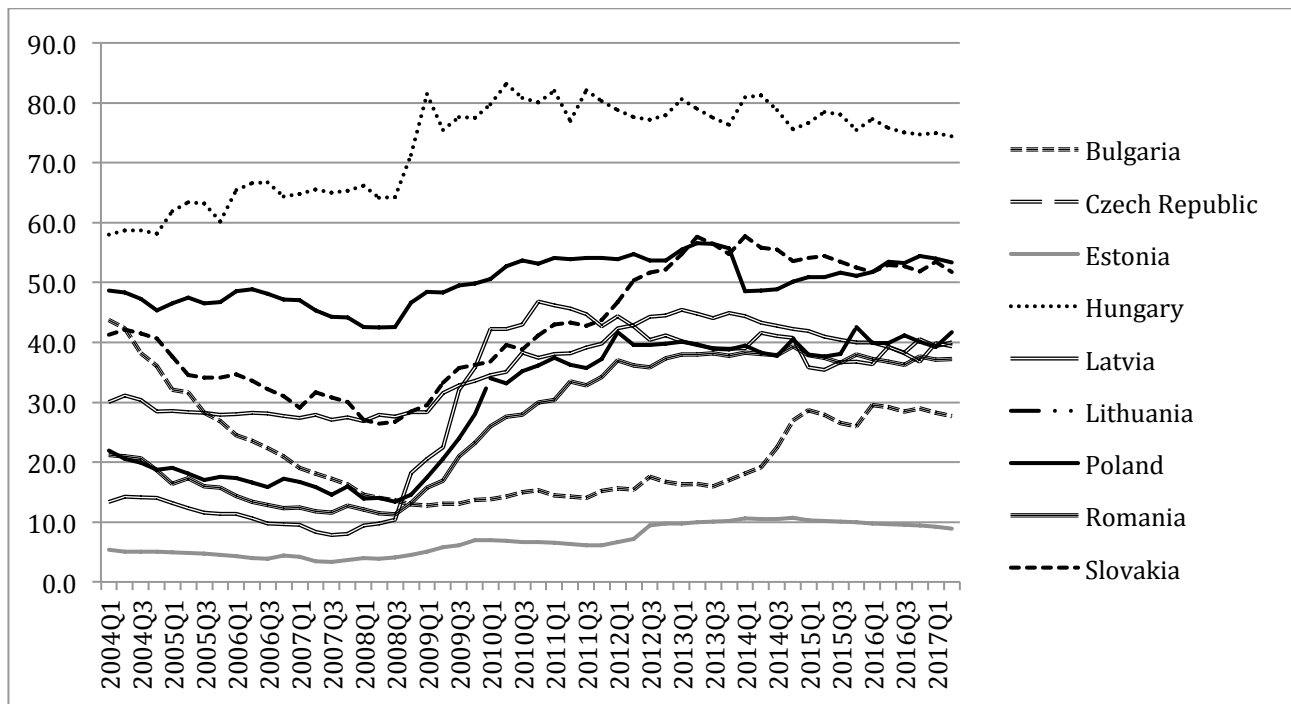
¹ Importantly, as the only country in the EU Poland has not suffered a single quarter of recession and over the years 2007-2017 its cumulative GDP increase was about 25% compared to 0% for the whole UE. This means that changes in the fiscal framework were conducted in relatively less severe economic conditions than in some other member states.

2. Stylized facts

The key facts about the development of public finance and its sustainability in Poland, which will be analyzed in more depth in the subsequent sections, can be summarized in three main points.

Firstly, the government consolidated gross debt in Poland had been growing steadily (similarly as in the other CEE countries) since 2008 Q4 until 2014 Q1 (see Chart 1). It resulted from a fiscal expansion on the one hand and from a huge drop in tax revenues after outbreak of global financial crisis on the other. What is noteworthy, the government consolidated gross debt in Poland has not exceeded 60% of GDP, which is the threshold level guaranteed by Article 216, Clause 5 of the Polish Constitution. Furthermore, a rapid drop in Poland's government gross consolidated debt in 2014 Q1 to a large extent was a result of the redemption of the government-bond share of open pension funds assets in the amount of 8.5% of GDP.

Chart 1: **Government consolidated gross debt (D) in CEE countries as percentage of GDP**

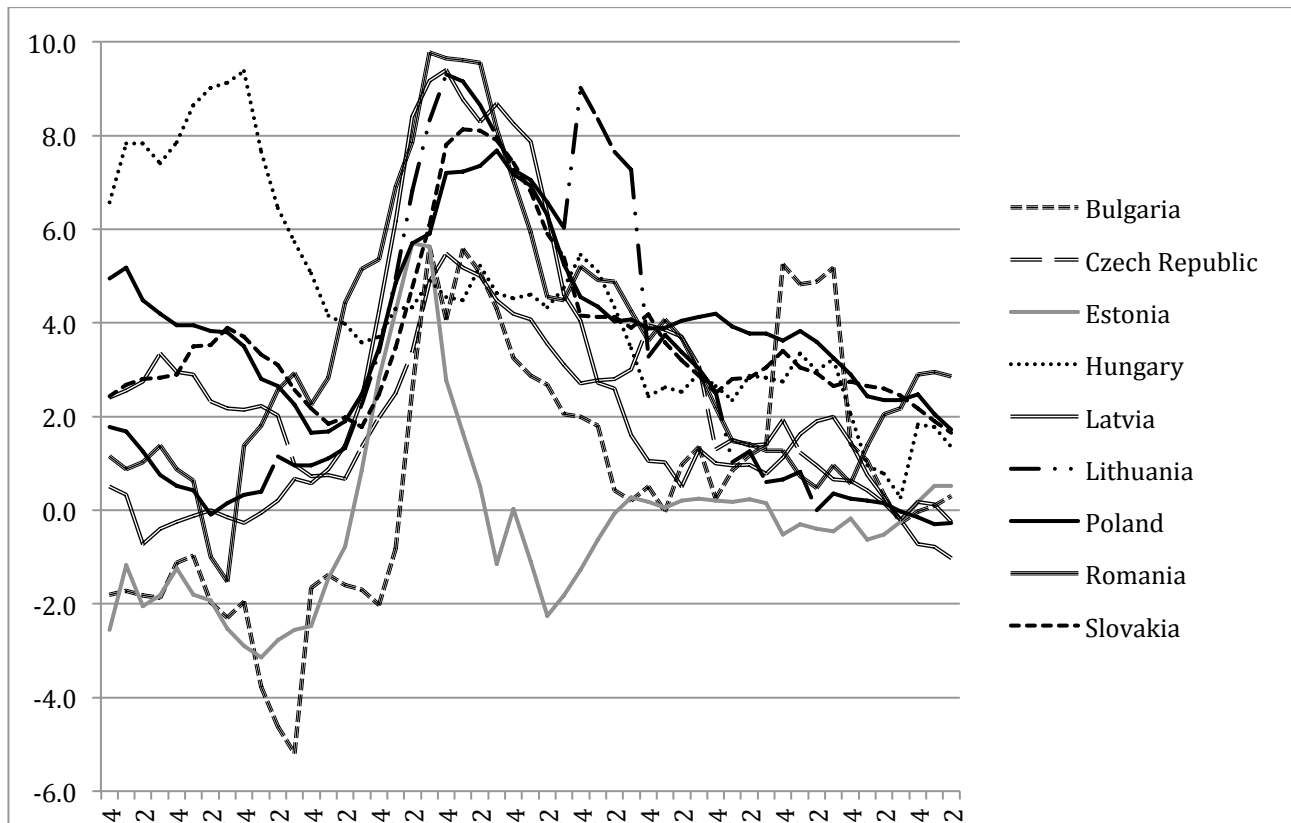


Source: own elaboration based on Eurostat

Secondly, the budget deficit in Poland during the first quarters of the crisis had been growing rapidly, reaching its peak at the level of 8.7% of GDP in 2009 Q4. In the years 2009-2015 Poland was under the Excessive Deficit Procedure. In the course of the Procedure, Polish governments (the First Cabinet of Donald Tusk until 2011 and the Second Cabinet of Donald Tusk thereafter) took measures to reduce the deficit and cooperated with the Commission and the Council to exit the Procedure (Poniatowski, Głowacki, 2017). Since 2010 Q1 the fiscal conditions in Poland

have begun to improve gradually (see Chart 2). What is important, in 2009 new precautionary measures were introduced into the Polish Public Finances Act, which included, among other things, the prohibition to increase wages and pensions should the relation of the government gross consolidated debt to GDP breach the level of 55%. Furthermore, in January 2011 Poland introduced a formal expenditure rule, which has had a positive impact upon the pace of the reduction of the budget deficit (see more detail in Działo, 2012).

Chart 2: Moving average of budget deficit (BB) as percentage of GDP

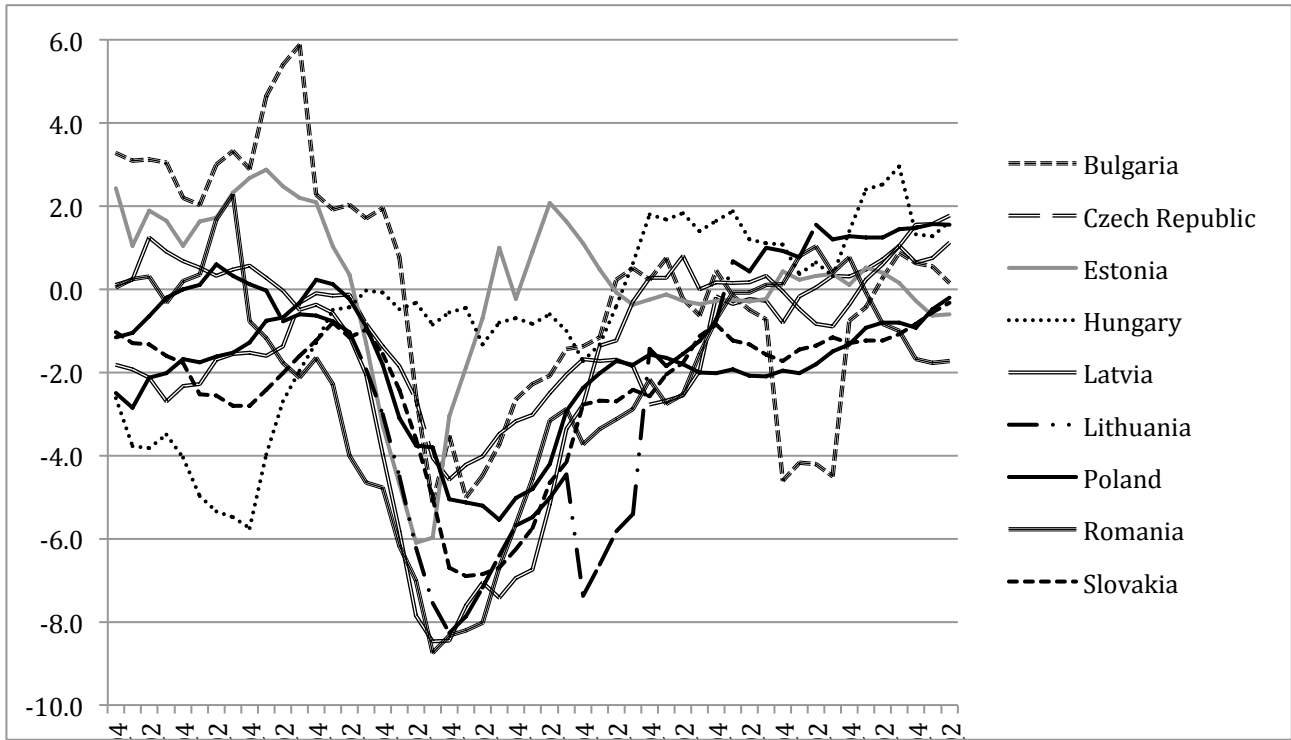


Source: own elaboration based on Eurostat

Thirdly, the entire CEE region experienced massive impact of the global financial crisis on the levels of primary surpluses (see Chart 3). Fluctuations of primary surpluses in the crisis years 2008–2011 in the CEE countries were significantly higher than in the quiet times prior to the crisis. Almost every country had a significant primary budget deficit in the year 2009. Poland reached the pick of the primary deficit in 2009 Q4.

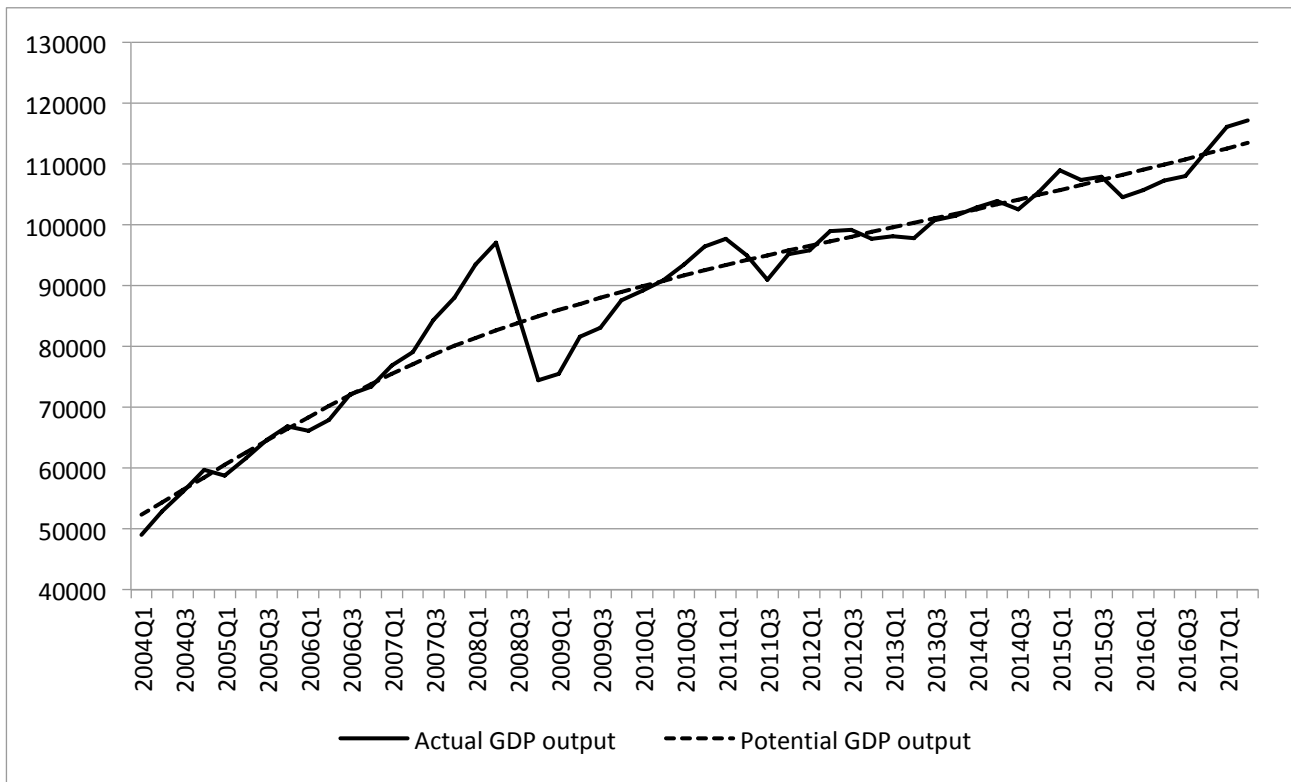
When looking at the output gap in Poland at the end of the year 2007 the Polish economy was at the peak of the macroeconomic cycle and after the outbreak of the global financial crisis it experienced strong economic slowdown. Since the beginning of the year 2012 the output gap in Poland has been fluctuating around the level of 0% of GDP. However, already in 2017 the output gap in Poland turned positive (see Chart 4).

Chart 3: Moving average of primary budget surplus (PS) as percentage of GDP



Source: own elaboration based on Eurostat

Chart 4: Actual GDP output vs potential GDP output in Poland (in thousands of EUR)



Source: own calculations based on Eurostat data with the usage of Hodrick–Prescott filter

Moving to a more detailed stocktaking, it is useful to examine developments of some key fiscal policy measures and institutional changes over the recent decade.

One of the most significant fiscal policy measures in Poland that has had a huge impact on the Polish economy during the global financial crisis was a significant tax reduction prior to the crisis. The following measures were implemented at that time by the former Law and Justice Party's government (Krajewski, Krajewska, 2011):

- reduction of the pension contribution (from 13% to 6%) in 2007,
- introduction of the family allowance deductible from PIT in 2007,
- lowering of the marginal tax levels and introduction of two brackets of the Personal Income Tax: 18% and 32% in 2009 (from a system of three brackets of 19%, 30% and 40%, respectively).

All of those decisions resulted in a large tax cut exactly when the slowdown from the euro area crisis arrived in Poland. In the very same moment the outflow of capital from emerging markets significantly depreciated the Polish currency, only several months after the new measures came into force. Both effects – the fiscal expansion and the depreciation of złoty – boosted the demand and as a result Poland survived the global recession without serious fiscal problems (Gomułka, 2016). The next government increased fiscal spending further, partially by utilizing available EU funds to help cover a series of investment program, many of which were connected to the preparations for the Euro 2012 football championship (Rae, 2012).

Shortly after, the Citizen Platform's government introduced significant institutional reforms of the fiscal framework, partially to stabilize investors' expectations about the current fiscal stance of the country as well as a longer-term view that some institutional reforms were necessary. Most important was the introduction of a formal government expenditure rule. The rule entered into force on 1 January 2011. According to this rule the state budget expenditure could increase every year only up to the inflation rate plus 1 percentage point (Działo, 2012). After some further modifications the Polish expenditure rule can be described as follows (Poniatowski, Głowacki, 2018):

$$G_t = G_{t-1}^* \times E_t[CPI_t] \times (FGDP_t + C_t) + E_t[DA_t]$$

where:

$E_t(CPI)$ - current CPI expectations,

G_t - government expenditure in time t ,

G_{t-1}^* - government expenditure in time $t-1$ adjusted by actual CPI,

$FGDP_t$ - adaptive real GDP forecast,

C_t - correction component, which depends on the value of the debt-to-GDP ratio,

DA_t - value of discretionary spending.

The design of the rule contributes to a reduction of the fiscal policy pro-cyclicality and as a result this institutional measure helped the Polish government stabilize public finances during the global financial crisis (Działo, 2012).

Last but not least, Poland was at the forefront of the EU institutional reforms: it fully implemented the so called 'six-pack' in 2011 aimed at strengthening the Stability and Growth Pact. The 'six-pack' stipulated six further measures (Delivorias, 2014):

1. enhancing the surveillance of the fiscal and economic policies under the European Semester,
2. strengthening the surveillance of the country through examining current account deficits, as well as current account surpluses,
3. introducing an expenditure rule, strictly related to a country medium-term budgetary objective (MTO),
4. allowing the excessive deficit procedure to be opened on the sole basis of the debt criterion (60% of GDP),
5. introducing a macroeconomic imbalance procedure based on an early-warning system,
6. in case of breaking the EU rules imposing graduated financial sanctions up to 0.5% of GDP.

In turn the regulations of the 'two-pack' that were introduced in 2013 concentrated on further improving budgetary coordination within the Euro Zone through the introduction of a common budgetary timeline for the Member States, and by introducing a system of enhanced surveillance for countries experiencing serious difficulties with financial stability (Delivorias, 2014). Some of the measures from the 'six-pack' had been introduced in Poland even earlier, especially when it comes to establishing the expenditure benchmark linked with the MTO (see Table 1). In fact, one can claim that the design of the Polish fiscal rules was aimed at supporting the execution of the EU rules (Marchewka-Bartkowiak, 2016).

Table 1: **Polish fiscal reforms vs. EU recommendations during the global financial crisis**

Date of implementation in Poland	Polish precautionary measures	EU's corresponding recommendation
December, 2010	<p>1st stage of consolidation of liquidity management in the public finance sector, i.e. strengthening of the state budget liquidity management system by:</p> <ul style="list-style-type: none"> • the obligation to invest free means of state earmarked funds, and other certain units of the public finance sector in the account of the Minister of Finance at Bank Gospodarstwa Krajowego (BGK), • possibilities for the local government units and other units of the public finance sector to allocate free funds in the form of a deposit held by the Minister of Finance at Bank Gospodarstwa Krajowego (BGK) 	none
January, 2011	<p>Introduction of the expenditure discipline rule to achieve sustainable public finances, which consisted of:</p> <ul style="list-style-type: none"> • limiting the growth of discretionary expenditures (so-called flexible) and new expenditures legally determined to the level of inflation rate increased by 1 percentage point, during the excessive deficit procedure, • stabilization of the general government deficit at the MTO, i.e. 1% of GDP, following the abrogation of the excessive deficit procedure. 	<p>From Six-pack</p> <p>Fiscal policy:</p> <ul style="list-style-type: none"> • Directive 2011/85/EU: <i>On requirements for budgetary frameworks of the Member States</i> – partially implemented in Poland

July, 2013	Further enhancing of the scope of expenditure discipline rule.	From Six-pack Fiscal policy: <ul style="list-style-type: none"> • Directive 2011/85/EU: On requirements for budgetary frameworks of the Member States – fully implemented in Poland
February, 2013	Pension system reform – redemption of the Polish T-bonds held by the open pension funds	none
March, 2015	2nd stage of consolidation of liquidity management in the public finance sector: <ul style="list-style-type: none"> • extending the obligation to deposit free funds in the form of a deposit held by the Minister of Finance for subsequent units of the public finance sector, • in the way of locating and collecting of funds deposited in the court deposit from court accounts in commercial banks to deposit accounts of the Minister of Finance at Bank Gospodarstwa Krajowego (BGK) and granting the Minister of Finance the right to temporarily use the funds deposited in the court deposit. 	none

Source: own elaboration based on the Ministry of Finance of Poland and the European Commission data

In general, owing to sound fiscal policy during the global financial crisis as well as the introduction of several new fiscal reforms that were consistent with new EU institutional measures, Poland had managed to significantly improve its fiscal condition. Since 2012 Q1 Polish public finances have been continuously improving. The budget deficit in 2009 Q4 achieved the level of 8,7% of GDP and in 2015 Q3 only 2,2% of GDP.

3. Measuring fiscal sustainability: literature review

Literature distinguishes two main approaches to examining fiscal sustainability: in the weak sense and in the strong sense. The first approach is primarily based on the stationarity tests of the relation of the public debt stock to GDP (Hamilton & Flavin, 1986; Wilcox, 1989; Trehan & Walsh, 1991) as well as on the testing of the presence of co-integrating vector between budgetary revenues and expenditures (Hakkio & Rush, 1991). Examining the fiscal sustainability in a strong sense, in turn, involves estimation of the fiscal reaction function in which the primary balance of the budget in relation to GDP is a dependent variable, while the level of the public debt in relation to GDP is an independent variable (Bohn, 1998, 2007). An interesting attempt to synthesize these two approaches mentioned above was a proposal of a Stepwise algorithm (Ozkaya, 2013), which uses the following procedure: a) sequentially testing the stationarity of the level of public debt stock in relation to GDP and primary balance in relation to GDP, b) searching for a co-integrating vector between budgetary revenues in relation to GDP and expenditures in relation to GDP, c) testing of the existence of a co-integrating vector between the primary balance in relation to GDP and the level of public debt stock in relation to GDP. It is worth noting that the Stepwise algorithm does not lead to the estimation of the individual fiscal response function.

Several recent studies have employed these different approaches to the analysis of fiscal sustainability for a set of the new EU member states, including Poland. For example, Krajewski et al.(2016) have used panel stationarity and cointegration tests as well as estimates of certain parameters of fiscal reaction function for Bulgaria, the Czech Republic, Estonia, Lithuania, Latvia, Poland, Slovakia, Romania and Hungary. They found out that despite financial turmoil these countries demonstrated the existence of a long-term relationship between revenues and expenditures and they have statistically relevant parameters of the fiscal reaction function. The study indicates that public finances in those countries were sustainable only in the weak sense, whereas panel data analysis used in the paper limits somewhat inferences on individual countries.

In another recent study Wysocki (2017) uses the stepwise algorithm based on quarterly data for a number of countries from Central and Eastern Europe. He also finds evidence of sustainability of fiscal policy in the CEE countries. In that study, the author shows the existence of a long term relationship between government expenditure and revenues. However, such an approach made it possible to examine fiscal sustainability only in a weak sense. Furthermore, in this article there was no attempt to estimate individual fiscal reaction functions. Similar limitation is included in the study

of Poland's fiscal stability by Pączek-Jarmulska (2016), in which the author, based on a yearly data, confirmed fiscal sustainability in Poland only in a weak sense.

The European Commission (EC) evaluates long-term fiscal sustainability of member states. It uses the proprietary debt sustainability analysis approach, which highlights two approaches: analysis of the fiscal sustainability indicators and deterministic projections of the level of public debt in a 10-year horizon, stochastic projections of the level of public debt stock in a 5-year horizon. Deterministic debt level projections conducted on the basis of macro-fiscal forecasts, over a longer horizon, in relation to the following variables: real GDP growth, inflation, real interest rates, the primary government and local government balance and other stock-flow adjustments. Due to the uncertainty of forecasts and assumptions, debt paths consistent with alternative scenarios are also subsequently developed. Finally, the fiscal reaction functions are estimated on the basis of data for individual countries, and if it is not possible – using the panel models. (European Commission, 2016). In turn, stochastic projections are developed over a shorter horizon. Distributions of debt levels are summarized and presented using fan charts, which illustrate debt paths corresponding to various macroeconomic conditions, obtained owing to shocks to variables determining debt dynamics. The assessment of the fiscal sustainability is based on two measures: the probability that at the end of the projection horizon the public debt stock will not exceed the level of the initial year and the difference between the 10th and 90th percentile of the distribution in the final year of a projection. The probability distribution of the level of debt in individual years is obtained using the Monte Carlo simulations. (European Commission, 2016). An important added value of the EC approach comes from including demographic factors related to the ageing of societies in Europe. In the most recent report, the EC finds that over the long run Poland faces medium risks to fiscal sustainability (European Commission, 2018). While the EC's analysis is with no doubt comprehensive, its limitation is the derivation of the actual debt path projections from the assumed normal distribution with non-dynamic covariance matrix. It does not capture the actual historical data, it captures a different aspect of what we are doing, because the EC's approach is forward-looking.

4. Data and Estimation Methods

We use quarterly data from Eurostat for the period from 2004 Q1 to 2017 Q2 for the following time series: government consolidated gross debt (D), budget deficit (BB), primary budget surplus (PS) and output gap (OG). The output gaps were calculated using the Hodrick–Prescott filter (1997). The unit of all the variables was percentage of GDP. We use data starting from the

year 2004 as we intend to evaluate the period around Poland's accession to the EU up till the year 2017.

Our approach involves three stages. Firstly, we verify data quality and examine the integration level of key variables using ADF, KPSS, PP and Zivot-Andrews tests (1992). Secondly, we run co-integration analysis using the Johansen test (1991) and the Lütkepohl-Saikkonen-Trenkler test (2004). Thirdly, we estimate the fiscal reaction functions using the methodology explained in more depth below. We run the tests for the whole period between 2004 Q1-2017 Q2 and then we split the sample into the pre-crisis period from 2004 Q1 to 2008 Q3 and the post-crisis period from 2008 Q4 to 2017 Q2 and run sensitivity and robustness tests².

As indicated earlier, we aim to analyze the fiscal sustainability in a strong sense. To this end we use the following methods: a) unit root tests for public debt stock, primary budget balance and output gap in relation to GDP, b) co-integration analysis of the above-mentioned aggregates (in particular between the primary balance of the budget and the level of public debt in relation to GDP), c) estimation of the fiscal reaction functions in which the primary balance of the budget is our dependent variable, and the level of public debt stock and the output gap are key independent variables (see Bohn, 1995).

Our approach adds value to the previous studies on three levels. Firstly, when examining the integration order of time series of the variables we include additional tests that go beyond classic tests, such as ADF, KPSS and PPP, the Zivot-Andrews test, which investigates the presence of structural breaks (Zivot, Andrews, 1991). Secondly, in conducting the co-integration analysis apart from the standard Johansen test (1991) we also use the Lütkepohl-Saikkonen-Trenkler test, which takes into account the effect of structural breaks (Lütkepohl, Saikkonen, 2000; Trenkler, 2003; Lütkepohl, Saikkonen, Trenkler, 2004; Konopczak, 2012). Thirdly, we use quarterly data which provide a greater number of degrees of freedom to estimate the individual fiscal reaction functions.

The idea behind the estimation algorithm in Zivot-Andrews test is to choose the date of the structural break for the point in time which gives the least favourable result for the null hypothesis of a random walk with drift. Contrary to Perron, Zivot and Andrews proposed that this break point is set endogenously, because then the risk of data mining is minimised (Zivot & Andrews, 1992).

The test statistic in Zivot-Andrews test is Student t ratio:

$$t_{\hat{\alpha}} = \inf_{\lambda \in \Delta} t_{\hat{\alpha}}(\lambda) \quad (1)$$

where Δ is a subset of (0;1).

² There is some discussion as to the date of the crisis. Given that the outbreak of the financial turmoil took place in 2008 Q3, we decided, similarly to Szyszka (2009), to choose the year 2008 as the beginning of the global financial crisis.

In a model with break both in intercept and trend the test statistic is inferred from the following test regression (Pfaff, 2008):

$$y_t = \hat{\mu} + \hat{\theta}DU_t(\hat{\lambda}) + \hat{\beta}t + \hat{\gamma}DT_t^*(\hat{\lambda}) + \hat{\alpha}y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-1} + \hat{\varepsilon}_t \quad (2)$$

where

$DU_t(\lambda) = 1$, if $t > T$ and 0 otherwise;

$DT_t^*(\lambda) = t - T\lambda$ for $t > T\lambda$ and 0 otherwise.

Lütkepohl, Saikkonen and Trenkler (2004) proposed a procedure for estimating a VECM in which the structural break is a simple shift in the level of the process and the date of break is estimated first. Next, the deterministic part, including the size of the shift, is estimated, and the data is adjusted accordingly. Finally, a Johansen-type test for determining the co-integration rank can be applied to these adjusted series (Pfaff, 2008).

Lütkepohl et al. assumed that the $(K \times 1)$ vector process $\{y_t\}$ is generated by a constant, a linear trend, and level shift terms:

$$y_t = \alpha_0 + \alpha_1 t + \alpha d_{t\tau} + x_t \quad (3)$$

where

$d_{t\tau}$ is a dummy variable defined by $d_{t\tau} = 0$ for $t < \tau$,

$d_{t\tau} = 1$ for $t \geq \tau$.

The shift assumes that the shift point τ is unknown and is expressed as a fixed fraction of the sample size. The estimation of the break point is based on the regressions:

$$y_t = v_0 + v_1 t + \alpha d_{t\tau} + A_1 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t \text{ for } t = p + 1, \dots, T \quad (4)$$

where

A_i with $i = 1, \dots, p$ assign the $(K \times K)$ coefficient matrices,

ε_t is the spherical K -dimensional error process.

The estimator for the break point $\hat{\tau}$ is then defined as:

$$\hat{\tau} = \arg \min_{\tau \in \underline{\tau}, \overline{\tau}} \det(\sum_{t=p+1}^T \hat{\varepsilon}_{tr} \hat{\varepsilon}'_{tr}) \quad (5)$$

where

$\underline{\tau} = [T\underline{\tau}, T\overline{\tau}]$ and determines how many regressions have to be run with the corresponding step dummy variables $d_{t\tau}$

$0 < \underline{\tau} \leq \tau \leq \overline{\tau} < 1$, where $\underline{\tau}$ and $\overline{\tau}$ define real numbers and $[\cdot]$ defines the integer part,

$\hat{\varepsilon}_{tr}$ are the least-squares of equation (5).

Once the break point $\hat{\tau}$ is estimated, the data are adjusted according to:

$$x_t = y_t + \hat{\alpha}_0 + \hat{\alpha}_1 t + \hat{\alpha}_2 d_{t[\hat{\tau}]}, \quad (6)$$

Following Krajewski, Mackiewicz, Szymańska (2016) we estimated the parameters of the following behavioural equation:

$$PS_t = \alpha_0 + \alpha_1 PS_{t-1} + \beta_0 OG_t + \beta_1 OG_{t-1} + \gamma_1 D_{t-1} + \varepsilon_t \quad (7)$$

where

PS_t – primary surplus,

PS_{t-1} – primary surplus 1 period lagged,

OG_t – output gap,

OG_{t-1} – output gap 1 period lagged,

D_{t-1} – public debt stock 1 period lagged.

The key parameter is γ_1 , which indicates the reaction of primary surplus to the changing level of public debt in the previous period. If this parameter is significantly different from zero (positive), this means that the growing stock of public debt effectively leads to generating an improvement in primary deficit, thus ensuring the long-run solvency of the public sector.

5. Results of the econometric analysis

We first checked the level of integration of every budgetary variable for Poland. In doing so, we have used 4 different unit root tests ADF, PP, KPSS and Zivot-Andrews. However, the ultimate criterion for us was the result of Zivot-Andrews test. For our calculations we have used GNU R and a package urca (see Appendix 1). In every test we have chosen the level of significance of 5%. In line with our previous data exploration in all cases we have accepted hypothesis about the existence of structural break. Our analysis reveals that the use of Zivot-Andrews test was justified (see Table 2).

Table 2: **Unit root test results of primary surplus (PS), public debt stock (D) and output gap (OG) for Poland**

Variable	ADF	PP	KPSS	ZA (intercept & trend)			
				order	test statistic	critical value at $\alpha=5\%$	break
Primary surplus (PS)	I(2)	I(0)	I(0)	I(2)	-12.2056	-4.8	2010Q4
Public debt stock (D)	I(1)	I(1)	I(1)	I(2)	-5.8836	-4.8	2014Q1
Output gap (OG)	I(0)	I(1)	I(1)	I(0)	-6.7067	-5.08	2008Q4

Source: own calculations

Contrary to Paćzek-Jarmulska (2016) our analysis, based on the Zivot-Andrews, reveals that the tests of both primary surplus and public debt stock were integrated at the same level $I(2)$, so further co-integration analysis would be justified. The structural break in the output gap occurred as expected in 2008 Q4, but visible impact of economic slowdown upon the primary surplus in Poland occurred a few quarters later, so the structural break in primary surplus appeared in 2010 Q4. Furthermore, the structural break of Polish public debt stock in 2014 Q1 was related to the redemption of some series of T-bonds as a result of the reform of the Polish pension system (Wysocki, 2017).

Next, we tested the cointegration of the variables. The test shows that according to the maximal eigenvalue test of Johansen-Procedure (1991), at the level of significance of 5% (see Table 3), in Poland at least one co-integration vector of primary surplus (PS), public debt stock (D) and output gap (OG) exists.

Table 3: Values of test statistic and critical values of maximal eigenvalue statistic of Johansen-Procedure

Number of vectors	test	10pct	5pct	1pct
$r \leq 2$	3.74	6.5	8.18	11.65
$r \leq 1$	8.10	12.91	14.9	19.19
$r = 0$	27.07	18.9	21.07	25.75

Source: own calculations

However, because – as we showed earlier with the Zivot-Andrews test – there are structural breaks in these time series, we finally used the Lütkepohl-Saikkonen-Trenkler trace test (2004) with the critical values from Trenkler (2003) (see Table 4). This test takes into account the presence of endogenous structural shifts in the time series, because it includes shift correction in the linear trend. The test also confirmed that at the level of significance of 5% in Poland at least one co-integration vector of primary surplus (PS), public debt stock (D) and output gap (OG) exists.

Table 4: Values of test statistic and critical values of trace statistic of Lütkepohl-Saikkonen-Trenkler test

Number of vectors	test	10pct	5pct	1pct
$r \leq 2$	6.30	5.42	6.79	10.04
$r \leq 1$	19.30	13.78	15.83	19.85
$r = 0$	35.1	25.93	28.45	33.76

Source: own calculations

After conducting the integration order and co-integration analysis we moved to estimating the fiscal reaction function. The structure of the fiscal reaction function is in the line with former specifications by Bohn (2007) and Krajewski, Mackiewicz & Szymańska (2016). Due to the fact that we use quarterly data, all variables were lagged by 4 instead of 1:

$$PS_t = \alpha_0 + \alpha_1 PS_{t-4} + \beta_0 OG_t + \beta_1 OG_{t-4} + \gamma_1 D_{t-4} + \varepsilon_t \quad (8)$$

where

PS_t – primary surplus,

PS_{t-4} – primary surplus 4 quarters lagged,

OG_t – output gap,

OG_{t-4} – output gap 4 quarters lagged,

D_{t-4} – public debt stock 4 quarters lagged.

Next, we estimated the fiscal reaction function for Poland for the whole period from 2004 Q1 to 2017 Q2 (see Table 5). The estimation of the γ_1 parameter of the lagged public debt stock (D4) is positive and statistically significant, which means that the fiscal policy in Poland within this period has been sustainable in the strong sense. Furthermore, in almost every country the estimation of the majority of parameters are statistically significant and the results of the F-statistic confirm the proper specification of the models.

Table 5: Fscal reaction functions for Poland from 2004 Q1 to 2017 Q2

Coefficients	Estimate	Std. Error	t value	Pr(> t)	F-statistic	p-value	Adjusted R-squared
(Intercept)	-8.48962	2.99832	-2.831	0.0069 **	7.441 on 4 and 45 DF	1.09E-04	0.3446
PS4	0.55059	0.12596	4.371	7.21E-05 ***			
OG	0.06635	0.04602	1.442	0.1563			
OG4	-0.01698	0.04840	-0.351	0.7274			
D4	0.15418	0.06012	2.565	0.0137 *			

Source: own calculations

We then split the sample to investigate the fiscal outcomes prior to and after the crisis. The analysis shows that for the period 2004 Q1 to 2008 Q3 the γ_1 parameter is positive, but not statistically significant (see table 6). For the period from 2008 Q4 to 2017Q2, the γ_1 parameter is positive and statistically significant, which means that the fiscal policy in Poland has been sustainable in a strong sense since 2008 Q4 (see Table 7).

Of course, the results for this earlier pre-crisis period are estimated on a shorter sample, but in the light of the post-crisis period and for the entire EU membership period it can be said that the post-crisis times imposed on the Polish government more fiscal discipline in the medium and longer

term, which is in the line with our earlier analysis of the policy and institutional measures that have been undertaken both by the Polish government as well as by the European Commission.

Table 6: Estimation results of the fiscal reaction functions for Poland from 2004 Q1 to 2008 Q3

Coefficients	Estimate	Std. Error	t value	Pr(> t)	F-statistic	p-value	Adjusted R-squared
(Intercept)	-26.82728	20.4400	-1.312	0.219	2.547 on 4 and 10 DF	0.1051	0.3065
PS4	0.62989	0.34854	1.807	0.101			
OG	-0.08150	0.08279	-0.984	0.348			
OG4	0.18791	0.19003	0.989	0.346			
D4	0.57735	0.42912	1.345	0.208			

Source: own calculations

Table 7: Estimation results of the fiscal reaction functions for Poland from 2008 Q4 to 2017 Q2

Coefficients	Estimate	Std. Error	t value	Pr(> t)	F-statistic	p-value	Adjusted R-squared
(Intercept)	-12.14877	3.51475	-3.457	0.001657 **	11.23 on 4 and 30 DF	1.093E-05	0.5461
PS4	0.46872	0.11830	3.962	0.000424 ***			
OG	0.19921	0.07687	2.592	0.014617 *			
OG4	0.08874	0.04901	1.811	0.080215 .			
D4	0.21766	0.06726	3.236	0.002951 **			

Source: own calculations

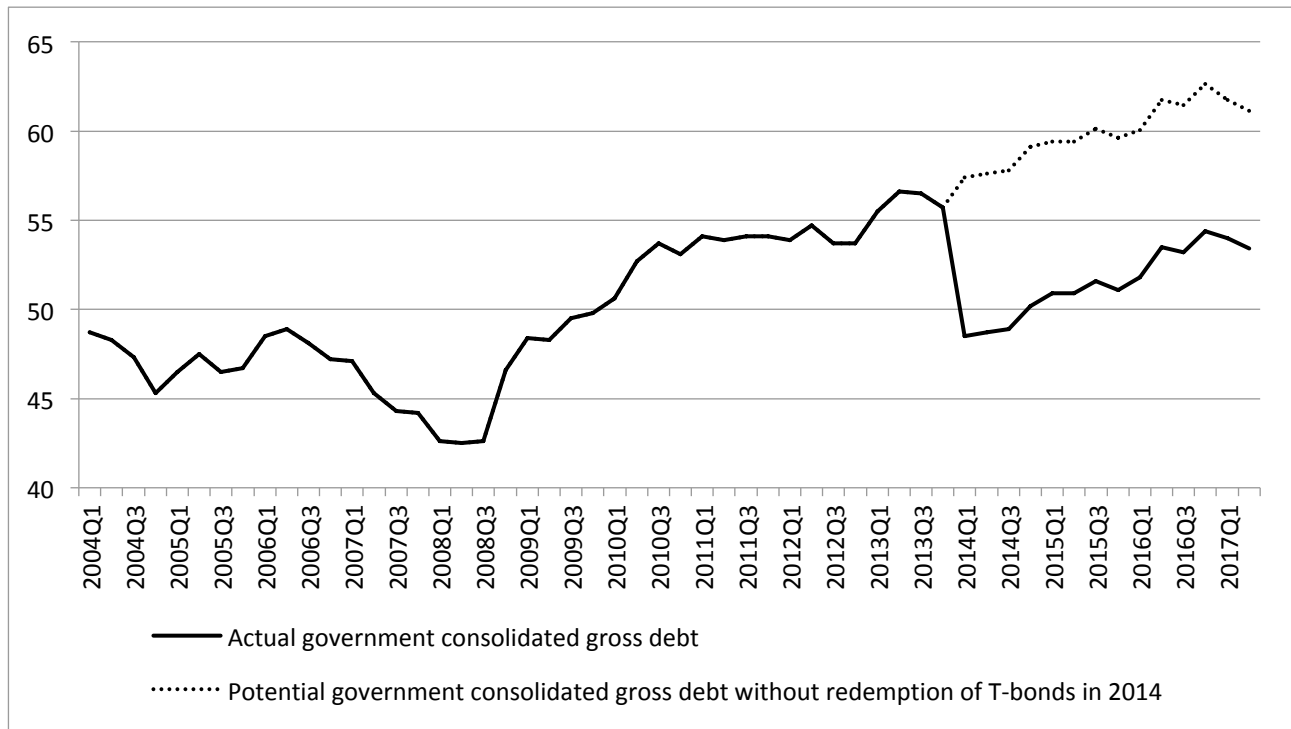
5. Pension System Funds Amendments: a robustness check.

The analysis presented in the previous section suggests that the fiscal framework in Poland strengthened in the aftermath of the crises and the EU policy measures: we discovered both improvement of the fiscal sustainability parameters and a structural break in the fiscal outcomes after the crisis. We now move to explore if our results are not biased by a one-off redemption of T-bonds in the amount of nearly 8.5% of GDP that the government implemented in the context of the reform of the Polish pension system in 2014 (described earlier in section 2). To that end, we have generated time series with potential government consolidated gross debt without the redemption of PLN 153.2b of T-bonds related to the government-bond share of the open pension funds. In doing so, we assume that the debt dynamics would remain the same as in the case of the actual realization of the Polish public debt stock (see Chart 5).

Our analysis shows that redemption of some series of T-bonds in 2014 Q1 had no impact upon our results since both for the period from 2004 Q1 to 2017 Q2, as well as from 2008 Q4 to

2017 Q2, the γ_1 parameters are positive and statistically significant, which means that the fiscal policy in Poland during the global financial crisis has been sustainable in a strong sense regardless of the redemption of the government-bond share of the open pension funds (see Table 8 and Table 9). Obviously, these results need more scrutiny in further research because without the redemption of the T-bonds the public debt could have likely exceeded constitutional limits of 60% of GDP. At the same time the output gap was 0 or positive between 2013-2015. Moreover, the statutory and constitutional public debt thresholds existing in Poland are related to the domestic and not the EU definition of the public finance sector and it has been an often used practice of the governments to use that difference to lower the trajectory of the official public debt according to the domestic definition – that mechanism would be very likely used in the event of approaching the constitutional debt limits of 60% of GDP lowering the impact of debt trajectory on fiscal expenditure, output gap and growth. In Poland, the scope of the sector is specified exhaustively in art. 9 of the Public Finance Act. Meanwhile, the EU methodology (according to the European system of national accounts ESA 2010) contains additional functional criteria (such as the structure of financing) which allow to assign individual entities as belonging to or not to the general government sector, regardless of different legal orders of the 28 EU Member States. Currently, the most important difference between the domestic and EU definition of the public finance sector is the National Road Fund managed by Bank Gospodarstwa Krajowego, which is not part of the Polish public finance sector and has been classified as a general government in accordance with ESA 2010.

Chart 5: **Actual vs potential government consolidated gross debt in Poland without redemption of T-bonds in 2014 as percentage of GDP**



Source: own elaboration based on Eurostat and Ministry of Finance of Poland

Table 8: **Estimation results of fiscal reaction functions for Poland from 2004 Q1 to 2017 Q2 for gross consolidated debt without the effect of the redemption of the government-bond share of the open pension funds**

Coefficients	Estimate	Std. Error	t value	Pr(> t)	F-statistic	p-value	Adjusted R-squared
(Intercept)	-7.37635	2.11326	-3.491	0.001091 **	8.601 on 4 and 45 DF	3.034E-05	0.3829
PS4	0.49810	0.12235	4.071	0.000187 ***			
OG	0.07357	0.04482	1.642	0.107646			
OG4	-0.01576	0.04644	-0.339	0.735888			
D4	0.12523	0.04005	3.127	0.003091 **			

Source: own calculations

Table 9: **Estimation results of fiscal reaction functions for Poland from 2008 Q4 to 2017 Q2 for the gross consolidated debt without the effect of the redemption of the government-bond share of the open pension funds**

Coefficients	Estimate	Std. Error	t value	Pr(> t)	F-statistic	p-value	Adjusted R-squared
(Intercept)	-17.26222	3.72530	-4.634	8.84E-05 ***	17.76 on 4 and 45 DF	3.857E-07	0.6908
PS4	0.25440	0.13643	1.865	0.073553 .			
OG	0.15516	0.08800	1.763	0.089637 .			

OG4	0.06402	0.05499	1.164	0.254886			
D4	0.28941	0.06353	4.556	0.000109 ***			

Source: own calculations

Conclusions

In this paper we have analyzed the fiscal sustainability in Poland. Unlike previous studies, we looked specifically at the fiscal outcomes prior to and after the global financial crisis and the sovereign debt crisis that led to several new institutional measures on the EU and the national level. Moreover, we have analyzed the fiscal sustainability in the strong sense, as compared to previous studies that analyzed weak measures of the fiscal sustainability.

Our results show that the fiscal policy in Poland has been sustainable in the strong sense up until 2017. At the same time the analysis reveals that the fiscal sustainability in Poland has significantly improved in the post-crisis period of 2009-2017: we discovered both improvement of the fiscal sustainability parameters and the structural breaks in the fiscal outcomes after the crisis. Namely, compared to the whole sample of 2004-2017 the strength of the reaction of the primary deficit to a change of public debt increased in the post-crisis times by nearly 50%. What is important, these results are robust with respect to the pension fund reform which led to a one-off redemption of T-bonds in amount of 8.5% of GDP. The analysis also reveals a cycle of structural breaks of 2-and 4 years lags: for output gap in 2008 Q4, for primary deficit in 2010 Q4 and for public debt in 2014 Q1 which led to a closure of the excessive deficit procedure in 2015 Q2. A massive social expenditure program introduced in 2017 was made possible due to the improved fiscal policy outcomes, but it may present a regime shift that should be verified in the near future. In fact, the social program was coupled with measures that water down some of the key provisions of the domestic expenditure rule, which raises a question of what needs to be present in a member states fiscal framework in order to make any improvements in the fiscal framework robust to reduced market pressure and political cycles.

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Appendix 1

GNU R code with the most important functions and objects, which were used in calculations and statistical analysis

```
# INTEGRATION----
```

```
library(tseries)
```

```
library(urca)
```

```
#d_adf_PS<- adf.test(x[,6])
```

```
d_pp_PS<- pp.test(x[,6])
```

```
d_kpss_PS<- kpss.test(x[,6])
```

```
d_za_PS_bot<- summary(ur.za(x[,6],model="both",lag=4))
```

```
d_adf_D<- adf.test(x[,2])
```

```
d_pp_D<- pp.test(x[,2])
```

```
d_kpss_D<- kpss.test(x[,2])
```

```
d_za_D_bot<- summary(ur.za(x[,2],model="both",lag=4))
```

```

d_adf_OG<- adf.test(x[,7])
d_pp_OG<- pp.test(x[,7])
d_kpss_OG<- kpss.test(x[,7])
d_z_za_OG_bot<- summary(ur.za(x[,7],model="both",lag=4))

#
d_adf_PS_1<- adf.test(diff(x[,6]))
d_pp_PS_1<- pp.test(diff(x[,6]))
d_kpss_PS_1<- kpss.test(diff(x[,6]))
d_z_za_PS_1_bot<- summary(ur.za(diff(x[,6]),model="both",lag=4))

d_adf_D_1<- adf.test(diff(x[,2]))
d_pp_D_1<- pp.test(diff(x[,2]))
d_kpss_D_1<- kpss.test(diff(x[,2]))
d_z_za_D_1_bot<- summary(ur.za(diff(x[,2]),model="both",lag=4))

d_adf_OG_1<- adf.test(diff(x[,7]))
d_pp_OG_1<- pp.test(diff(x[,7]))
d_kpss_OG_1<- kpss.test(diff(x[,7]))
d_z_za_OG_1_bot<- summary(ur.za(diff(x[,7]),model="both",lag=4))

#
d_adf_PS_2<- adf.test(diff(diff(x[,6])))
d_pp_PS_2<- pp.test(diff(diff(x[,6])))
d_kpss_PS_2<- kpss.test(diff(diff(x[,6])))
d_z_za_PS_2_bot<- summary(ur.za(diff(diff(x[,6]),model="both",lag=4)))

d_adf_D_2<- adf.test(diff(diff(x[,2])))
d_pp_D_2<- pp.test(diff(diff(x[,2])))
d_kpss_D_2<- kpss.test(diff(diff(x[,2])))
d_z_za_D_2_bot<- summary(ur.za(diff(diff(x[,2]),model="both",lag=4)))

d_adf_OG_2<- adf.test(diff(diff(x[,7])))
d_pp_OG_2<- pp.test(diff(diff(x[,7])))
d_kpss_OG_2<- kpss.test(diff(diff(x[,7])))
d_z_za_OG_2_bot<- summary(ur.za(diff(diff(x[,7]),model="both",lag=4)))

# COINTEGRATION----
library(urca)
PS_D_OG<-x[,c(6,2,7)]

# JOHANSEN
PS_D_OG_jo<-PS_D_OG, summary(ca.jo(x))

# TRENKLER-SAIKKONEN-LUETKEPOHL
PS_D_OG_tsl<-PS_D_OG, summary(cajolst(x))

##### REGRESSION
form<-as.formula(paste("PS~",paste(c("PS4","OG","OG4","D4"),sep=" ",collapse="+"),sep=""))
reg_ols<-summary(lm(form,data=x))

```

Appendix 2

GNU R code with the most important functions and objects, which were used in calculations of output gap

```
p1<-choose.dir()
n<-list.files(path=path)
p2<-paste(p1,"\\",n,sep="")

library(readxl)

y<- read_excel(path)

y<-as.data.frame(y)

z<-apply(y[,-1],2,log)

y2<-as.data.frame(cbind(y[,1],z))
```

```
library(mFilter)
```

```
y3<-apply(y2[,-1],2, hpfilter(x,freq=1600))
```