sciendo

International Journal of Management and Economics 2018; 54(3): 219–226

Research Article

Maciej Wysocki*, Cezary Wójcik

Sustainability of fiscal policy in Poland in the period 2004–2017

https://doi.org/10.2478/ijme-2018-0021
Received May 17, 2018; accepted September 28, 2018

Abstract: The aim of this paper is to analyze fiscal sustainability in Poland after joining EU between 2004-2017. Unlike previous studies, which analyzed weak measures of fiscal sustainability, we analyze fiscal sustainability measures in the strong sense. Contrary to previous studies we estimate individual, not panel, fiscal reaction functions which allows us to provide possibly a more accurate picture of fiscal policy outcomes in Poland. Moreover, our empirical analysis takes a closer look at the series of structural breaks that occurred after the global crisis. Based on our analysis we may tentatively conclude that despite cyclical fiscal deterioration during the crisis fiscal policy in Poland has been sustainable in the strong sense up until 2017.

Keywords: fiscal sustainability, fiscal policy, global crisis.
JEL: C22, E60, H63

1 Introduction

Fiscal policy sustainability has always been in the center of attention of policymaking in the European Union (EU), but after the recent global financial crisis and the sovereign debt crisis in the euro area, its role has increased even more. The global financial crisis of 2008 and the subsequent sovereign debt crisis in the euro area caused a drastic drop in budget revenues, which resulted in increased budget deficits in many countries, including Poland, which raised pertinent policy questions regarding long-term sustainability of public finances in these countries.

Several recent studies have shown that by and large, the group of Central and Eastern European member states, including Bulgaria, the Czech Republic, Estonia, Lithuania, Latvia, Poland, Slovakia, Romania, and Hungary, despite the initial fiscal problems in the period of the global financial crisis after 2008, managed to stabilize their fiscal policy [Bökemeier and Stoian 2016; Krajewski et al., 2016; Wysocki, 2017].

However, these studies only confirmed fiscal sustainability in a weak sense, as measured by obtaining suitable cointegrating vectors between budget revenues and expenditures in these countries. So far, there have been no studies that would attempt to verify the sustainability of fiscal policy by estimating individual fiscal reaction functions, which would also verify fiscal sustainability in a strong sense.

Our key research question is whether fiscal policy in Poland has been sustainable up until 2017 despite strong deterioration of public finances during the crisis.

The outline of the reminder of the paper is as follows. The next section presents literature on measuring fiscal sustainability. Section 3 provides data description and estimation methods. Section 4 presents the results of econometric tests. Section 5 concludes the paper.

***Corresponding author: Maciej Wysocki,** Warsaw School of Economics, Warsaw, Poland, E-mail: mw46600@doktorant.sgh.waw.pl
Cezary Wójcik, Warsaw School of Economics, CESifo, Warsaw, Poland,

2 Measuring fiscal sustainability: literature review

Literature distinguishes in principle two main approaches to examining fiscal sustainability: in the weak sense and in the strong sense. The former approach is primarily based on the stationarity tests of the relations of public debt stock to gross domestic product (GDP) [Hamilton and Flavin, 1986; Wilcox, 1989; Trehan and Walsh, 1991], as well as on the testing of the presence of cointegrating vectors between budgetary revenues and expenditures [Hakkio and Rush, 1991]. Examining 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 public debt in relation to GDP is an independent variable [Bohn, 1998, 2007]. An interesting attempt to synthesize these two approaches mentioned above is the 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 the primary balance in relation to GDP; b) searching for a cointegrating vector between budgetary revenues in relation to GDP and expenditures in relation to GDP; c) testing of the existence of a cointegrating 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 functions.

Several recent studies have used these different approaches to analyze the 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 the fiscal reaction function, for Bulgaria, the Czech Republic, Estonia, Lithuania, Latvia, Poland, Slovakia, Romania, and Hungary. They find 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 these countries were sustainable only in the weak sense, whereas panel data analysis used in the paper somewhat limits the 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 (CEE). He also finds evidence of sustainability of fiscal policy in CEE countries. In that study, the author proves the existence of a long-term relationship between government expenditure and revenues. However, such an approach allows the examination of fiscal sustainability only in a weak sense. Furthermore, in that article, there has been no attempt to estimate the individual fiscal reaction functions. A similar limitation is found in the study of Poland's fiscal stability by Pączek-Jarmulska [2016], in which the author – based on a yearly data – affirms the fiscal sustainability in Poland only in a weak sense.

The European Commission evaluates the long-term fiscal sustainability of member states. It uses the proprietary debt sustainability analysis approach, which highlights two approaches: analysis of fiscal sustainability indicators and deterministic projections of the level of public debt in the 10-year horizon; and stochastic projections of the level of public debt stock in the 5-year horizon. Deterministic projections of the debt level are prepared 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. In an aim to capture the potential changes in macroeconomic conditions in the future, sensitivity analyses are carried out. Finally, fiscal reaction functions are estimated on the basis of data for individual countries, and if it is not possible, with the usage of 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 as a result of the shocks to the variables determining debt dynamics. The assessment of 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 percentiles of the distribution in the final year of projection. The probability distribution of the level of debt in individual years is obtained using Monte Carlo simulations [European Commission, 2016]. An important added value of the European Commission's approach is including the demographic factors related to the problem of the ageing of societies in Europe in the methodology. In the most recent report, the European Commission finds that over the long run, Poland faces medium risks to fiscal sustainability [European Commission, 2018]. While the analysis of the European Commission is without doubt comprehensive, its limitation is derivation of the actual debt path projections from the assumed normal distribution with a nondynamic covariance matrix. It does not capture the actual historical data; it captures a different aspect of what we are doing, because the approach of the European Commission is a forward-looking one.

3 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 are calculated using the Hodrick–Prescott filter [1997]. The unit of all the variables is percentage of GDP. We use data beginning from the year 2004 as we intend to evaluate the period from Poland's accession to EU up until 2017.

Our approach involves three stages. First, we verify data quality and examine the integration level of key variables using augmented Dickey-Fuller (ADF), Kwiatkowski–Phillips–Schmidt–Shin (KPSS), Phillips-Perron (PP), and Zivot-Andrews tests [1992]. Second, we run cointegration analysis using the Johansen test [1991] and the Lütkepohl-Saikkonen-Trenkler test [2004]. Third, we estimate the fiscal reaction functions using the methodology explained in more detail later. We run the tests for the whole period between 2004 Q1 and 2017 Q2, and then we split the sample into the precrisis period (from 2004 Q1 to 2008 Q3) and the postcrisis period (from 2008 Q4 to 2017 Q2) and thereafter run sensitivity and robustness tests.[1]

As indicated earlier, we aim to analyze 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) cointegration analysis of the abovementioned 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 the key independent variables [see Bohn, 1995].

Our approach adds value to the previous studies on three levels. First, in the case of the examination of the integration order of time series of the variables, we have included, in addition to the classic tests, tests such as ADF, KPSS, PP, and the Zivot-Andrews tests, which investigate the presence of structural breaks [Zivot and Andrews, 1992]. Second, application of the Lütkepohl-Saikkonen-Trenkler test in the cointegration analysis, which takes into account the effect of structural breaks [Saikkonen and Lütkepohl, 2000; Trenkler, 2003; Lütkepohl et al., 2004; Konopczak, 2012], alongside the standard Johansen test [1991]. Third, the usage of quarterly data, which provides for a greater number of degrees of freedom (DF) in the case of estimation of the individual fiscal reaction functions.

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

The test statistic in the Zivot-Andrews test is the Student's *t*-test:

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

where Δ is a subset of (0;1).

In a model with breaks in both intercept and trend, the test statistic is inferred from the following test regression [Pfaff, 2008]:

1 There is some debate as to the date of the crisis. Given that the outbreak of the financial turmoil took place in 2008 Q3, we decided – similar to Szyszka [2009] – to choose the year 2008 as the beginning of the global financial crisis.

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

where

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

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

Lütkepohl et al. [2004] proposed a procedure for estimating a vector error correction model (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 are adjusted accordingly. Finally, a Johansen-type test for determining the cointegration rank can be applied to these adjusted series [Pfaff, 2008].

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

$$y_t = \mu_0 + \mu_1 t + \delta d_{t\pi} + x_t \quad (3)$$

where d_t 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 following regression:

$$y_t = v_0 + v\, t + \delta d_{t\pi} + A_1 y_{t-1} + \ldots + A_p y_{(t-p)} + \varepsilon_t \quad (4)$$

where A_i with $i = 1, \ldots, p$ represents the (K × K) coefficient matrices; and ε_t is the spherical K-dimensional error process.

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

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

where $\mathfrak{I} = [T\underline{\lambda}, T\overline{\lambda}]$ determines how many regressions have to be run with the corresponding step's dummy variable $d_{t\tau}$; $0 < \underline{\lambda} \leq \lambda \leq \overline{\lambda} < 1$, where $\underline{\lambda}$ and $\overline{\lambda}$ define real numbers and [·] defines the integer part; and $\hat{\varepsilon}_{t\tau}$ represents the least squares of Equation (5).

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

$$\boldsymbol{x}_t = \boldsymbol{y}_t + \widehat{\boldsymbol{\mu}}_0 + \widehat{\boldsymbol{\mu}}_1 t + \widehat{\boldsymbol{\delta}} d_{t\hat{\tau}}, \quad (6)$$

Following Krajewski et al. [2016], we estimated the parameters of the following behavioral 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 one period lagged,
OG_t – output gap,
OG_{t-1} – output gap one period lagged, and
D_{t-1} – public debt stock one 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 generation of a fiscal surplus, thus ensuring the long-term solvency of the public sector.

4 Results of the econometric analysis

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

Contrary to the findings of Pączek-Jarmulska [2016], our analysis based on the Zivot-Andrews reveals that both primary surplus and public debt stock were integrated at the same level, namely, I(2), so further co-integration analysis would be justified. The structural break in output gap occurred as expected in 2008 Q4, but a visible impact of the 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 with the redemption of some series of Treasury bonds (T-bonds)as a result of the reform of the Polish pension system [Wysocki, 2017].

Table 1: Unit root test results of primary surplus (PS), public debt stock (D), and output gap (OG) for Poland

Variable	ADF	PP	KPSS	ZA (intercept and trend)			
				Order	Test statistic	Critical value at a=5%	Break
Primary surplus (PS)	I(2)	I(0)	I(0)	I(2)	−12.2056	−4.8	2010 Q4
Public debt stock (D)	I(I)	I(I)	I(I)	I(2)	−5.8836	−4.8	2014 Q1
Output gap (OG)	I(0)	I(I)	I(I)	I(0)	−6.7067	−5.08	2008 Q4

Source: own calculations.

Next, we tested the cointegration of the variables. The test shows that according to the maximal eigenvalue test of the Johansen procedure [1991] at the level of significance of 5% (Table 2), in Poland, there exists at least one cointegration vector primary surplus (PS), public debt stock (D), and output gap (OG).

Table 2: Values of the test statistic and the critical values of the maximal eigenvalue statistic of the Johansen procedure

Number of vectors	Test	10%	5%	1%
$r <= 2$	3.74	6.5	8.18	11.65
$r <= 1$	8.10	12.91	14.9	19.19
$r = 0$	27.07	18.9	21.07	25.75

Source: own calculations.

However, because of the existence of structural breaks in all the aforementioned macroeconomic time series in Poland, which has been proved earlier with the Zivot-Andrews test, the Lütkepohl-Saikkonen-Trenkler trace test [2004] with the critical values from Trenkler [2003] was used (Table 3). This test takes into account the presence of endogenous structural shifts in the time series, because it includes shift correction in the linear trend. This test also confirmed that at the level of significance of 5%, in Poland, there exists at least one cointegration vector primary surplus (PS), public debt stock (D), and output gap (OG).

Table 3: Values of test statistic and critical values of trace statistic of Lütkepohl-Saikkonen-Trenkler test

Number of vectors	Test	10%	5%	1%
$r <= 2$	6.30	5.42	6.79	10.04
$r <= 1$	19.30	13.78	15.83	19.85
$r = 0$	35.1	25.93	28.45	33.76

Source: own calculations.

After tests of integration order and cointegration analysis, we estimated the fiscal reaction function. The structure of the fiscal reaction function is in line with the former specifications by Bohn [2007] and Krajewski et al. [2016]. Because we used quarterly data, all variables were lagged by four instead of one:

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

where

PS_t – primary surplus,
PS_{t-4} – primary surplus four quarters lagged,
OG_t – output gap,
OG_{t-4} – output gap four quarters lagged, and
D_{t-4} – public debt stock four quarters lagged.

Next, we estimated the fiscal reaction function for Poland in our sample of 2004 Q1–2017 Q2 (Table 4). The estimation of parameter γ_1 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, the estimations of the majority of parameters are statistically significant, and the results of the *F*-statistic confirm the proper specification of the model.

Table 4: Estimation results of fiscal reaction function for Poland from 2004 Q1 to 2017 Q2

Coefficients	Estimate	Standard error	F-statistic	p-Value	Adjusted R-squared
(Intercept)	−8.48962	2.99832	7.441 on 4 and 45 DF	1.09E−04	0.3446
PS4	0.55059	0.12596			
OG	0.06635	0.04602			
OG4	−0.01698	0.04840			
D4	0.15418	0.06012			

Source: own calculations.

In our robustness check analysis, we split the sample to investigate the fiscal outcomes prior to and after the crisis. The analysis shows that for the period 2004 Q1–2008 Q3, the γ_1 parameter is positive but not statistically significant. 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 also since 2008 Q4 (Appendix 1). Furthermore, redemption of some series of T-bonds in 2014 Q1 for an amount of 8.5% of GDP had no impact upon our conclusions (Appendix 2)

5 Conclusions

The aim of this paper was to analyze the fiscal sustainability in Poland after integration into the EU between 2004 and 2017. Unlike previous studies, which analyzed weak measures of fiscal sustainability, we analyzed fiscal sustainability measures in the strong sense.

Contrary to previous studies, we estimated individual, not panel, fiscal reaction functions, which allowed us to provide possibly a more accurate picture of fiscal policy outcomes in Poland.

Moreover, our empirical analysis took a closer look at the series of structural breaks that occurred after the global crisis. The analysis reveals a cycle of structural breaks of 2- and 4-year lags: for output gap in 2008 Q4, for primary deficit in 2010 Q4, and for public debt in 2014 Q1. Our key research question was the following: has fiscal policy in Poland been sustainable up until 2017 despite strong deterioration of public finances during the crisis? Based on our econometric analysis, we may tentatively conclude that despite cyclical fiscal deterioration during the crisis, fiscal policy in Poland has been sustainable in the strong sense up until 2017. What is important, these results seem to be 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 in 2014 Q1.

References

Bohn, H. (1995), The sustainability of budget deficits in a stochastic economy, *Journal of Money, Credit and Banking*, Vol. 27, pp. 257–271.

Bohn, H. (1998), The behavior of U.S. public debt and deficits, *The Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 949–963.

Bohn, H. (2007), Are stationary and cointegration restrictions really necessary for the intertemporal budget constraint? *Journal of Monetary Economics*, Vol. 57, No. 7, pp. 1837–1847.

Bökemeier, B., Stoian, A. (2016), *Debt sustainability issues in the central and eastern European countries*, Working Papers in Economics and Management No.07-2016, Universität Bielefeld, Bielefeld.

European Commission. (2016), *Directorate-general for economic and financial affairs, fiscal sustainability report 2015*, Institutional Paper 018, Brussels.

European Commission. (2018), *Debt sustainability monitor 2017*, Institutional Paper 071, Brussels.

Hakkio, G.S., Rush, M. (1991), Is the budget deficit too large? *Economic Inquiry*, Vol. 29, pp. 429–445.

Hamilton, J.D., Flavin, M.A. (1986), On the limitations of government borrowing: a framework for empirical testing, *American Economic Review*, Vol. 76, No. 4, pp. 808–819.

Hodrick, R., Prescott, E.C. (1997), Postwar U.S. business cycles: an empirical investigation, *Journal of Money, Credit, and Banking*, Vol. 29, No. 1, pp. 1–16.

Johansen, S. (1991), Estimation and hypothesis testing of co-integration vectors in Gaussian vector autoregressive models, *Econometrica*, Vol. 59, pp. 1151–1181.

Konopczak, M. (2012), *Ocena ryzyka kredytowego Polski metodą roszczeń warunkowych, "Materiały i Studia NBP"*, Zeszyt nr 267, Narodowy Bank Polski, Warszawa.

Krajewski, P., Mackiewicz, M., Szymańska, A. (2016), Fiscal sustainability in central and eastern European countries – a post-crisis assessment, *Prague Economic Papers*, Vol. 25, No. 2, pp. 175–188.

Lütkepohl, H., Saikkonen, P. and Trenkler, C. (2004), Testing for the cointegrating rank of a VAR with level shift at unknown time, *Econometrica*, Vol. 72, No. 2, pp. 647–662.

Ozkaya, A. (2013), Public debt stock sustainability in selected OECD countries, *Central Bank Review*, Vol. 13, pp. 31–49.

Pączek-Jarmulska, B. (2016), Analiza stabilności fiskalnej w Polsce w latach 1995-2014, *Studia i Prace Kolegium Zarządzania i Finansów, Szkoła Główna Handlowa*, Vol. 151, pp. 47–70.

Pfaff, B. (2008), *Analysis of integrated and cointegrated time series with R*, Springer, New York.

Saikkonen, P., Lütkepohl, H., (2000), Testing for the cointegrating rank of a VAR process with structural shifts, *Journal of Business & Economic Statistics*, Vol. 18, No. 4, pp. 451–464.

Szyszka, A. (2009), Behawioralne aspekty kryzysu finansowego, *Bank i Kredyt*, No. 4, pp. 4–29.

Trehan, B., Walsh, C.E. (1991), Testing intertemporal budget constraints: theory and applications to U.S. federal budget and current account deficits, *Journal of Money, Credit, and Banking*, Vol. 23, pp. 206–223.

Trenkler, C. (2003), A new set of critical values for systems cointegration tests with a prior adjustment for deterministic terms, *Economics Bulletin*, Vol. 3, No. 11, pp. 1–9.

Wilcox, D.W. (1989), The sustainability of government deficits: implications of present-value borrowing constraint, *Journal of Money, Credit and Banking*, Vol. 21, No. 3, pp. 291–306.

Wysocki, M. (2017), Sustainability of public debt stock in transition economies in central and eastern Europe countries in terms of solvency, *Studia Ekonomiczne*, No. 1, pp. XCII.

Zivot, E., Andrews, D. (1992), Further evidence of the great crash, the oil-price shock and the unit-root hypothesis, *Journal of Business and Economic Statistics*, Vol. 10, No. 3, pp. 251–270.

Appendix 1

Robustness check analysis – additional estimations on the samples prior to and after the crisis

Table A1: Estimation results of the fiscal reaction functions for Poland from 2004 Q1 to 2008 Q3

Coefficients	Estimate	Std. error	F-statistic	p-Value	Adjusted R-squared
(Intercept)	−26.82728	20.4400	2.547 on 4 and 10 DF	0.1051	0.3065
PS4	0.62989	0.34854			
OG	−0.08150	0.08279			
OG4	0.18791	0.19003			
D4	0.57735	0.42912			

Source: own calculations.

Table A2: Estimation results of the fiscal reaction functions for Poland from 2008 Q4 to 2017 Q2

Coefficients	Estimate	Std. error	F-statistic	p-Value	Adjusted R-squared
(Intercept)	−12.14877	3.51475	11.23 on 4 and 30 DF	1.093E−05	0.5461
PS4	0.46872	0.11830			
OG	0.19921	0.07687			
OG4	0.08874	0.04901			
D4	0.21766	0.06726			

Source: own calculations.

Appendix 2

Robustness check analysis – additional estimations without the effect of the redemption of the government bond share of the open pension funds

Table A3: 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	F-statistic	p-Value	Adjusted R-squared
(Intercept)	−7.37635	2.11326	8.601 on 4 and 45 DF	3.034E−05	0.3829
PS4	0.49810	0.12235			
OG	0.07357	0.04482			
OG4	−0.01576	0.04644			
D4	0.12523	0.04005			

Source: own calculations.

Table A4: 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	F-statistic	p-Value	Adjusted R-squared
(Intercept)	−17.26222	3.72530	17.76on 4 and 45 DF	3.857E−07	0.6908
PS4	0.25440	0.13643			
OG	0.15516	0.08800			
OG4	0.06402	0.05499			
D4	0.28941	0.06353			

Source: own calculations.