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## TESTING FISCAL SUSTAINABILITY IN THE TRANSITION ECONOMIES OF EASTERN EUROPE: THE CASE OF POLAND (1999-2015)

### ABSTRACT

This paper reassesses the sustainability of public finances in Poland during the last two decades, characterized by the end of the macroeconomic stabilization phase and the implementation of several structural reforms. Cointegration tests allowing for regime-shifts reveal that fiscal policy is “weakly” sustainable, due to a significant divergence between revenues and expenditures in more recent years. Moreover, different from earlier research, I find strong support for bi-directional causality between revenues and expenditures. The main policy implication is that, in order to qualify for EMU membership, Poland should pursue further fiscal consolidation in the years ahead, implementing a more balanced fiscal-mix between revenue enhancement and expenditure reduction measures.

**Keywords:** Fiscal Sustainability, Transition Economies, Poland, Cointegration, Regime Shifts

**JEL Classification:** C22, E62, H62

### RIASSUNTO

*La sostenibilità della politica fiscale nelle economie post-comuniste dell'Est Europa:  
il caso della Polonia (1999-2015)*

L'articolo analizza la sostenibilità delle finanze pubbliche in Polonia nel corso degli ultimi due decenni, caratterizzati dalla fine della fase di stabilizzazione macroeconomica e dalla realizzazione di numerose riforme strutturali. L'applicazione di test di cointegrazione che incorporano la possibilità di breaks strutturali evidenzia che la politica fiscale è “debolmente” sostenibile, a causa di una significativa divergenza tra entrate e spese negli anni più recenti. Inoltre, diversamente dalla letteratura precedente, si riscontra l'esistenza di una significativa relazione di causalità bi-direzionale tra entrate e spese. La principale implicazione di politica economica è che, al fine di rispettare i criteri per l'ingresso nell'Unione Monetaria Europea, la

Polonia dovrebbe proseguire il processo di consolidamento fiscale nei prossimi anni, nel contesto di una politica fiscale piú equilibrata tra misure di aumento delle entrate e provvedimenti di riduzione della spesa pubblica.

## 1. INTRODUCTION

The analytical framework underlying the assessment of fiscal sustainability relies on the intertemporal budget constraint, according to which the current value of public debt must be equal to the expected present value of all future primary surpluses. This present value borrowing constraint is derived from the flow budget constraint faced by the government during each period ( $t$ ), and includes a limit term going to zero as ( $t$ ) tends to infinity (see e.g. Hakkio and Rush, 1991, section 2). This transversality condition ensures the absence of a debt with positive expected present value in the limit, therefore ruling out the existence of Ponzi schemes related to the financing of public expenditures.

Most empirical work assessing fiscal sustainability relies on two approaches based, respectively, on unit root and cointegration testing or on the estimate of fiscal reaction functions. The former approach implements stationarity tests on the discounted real debt series, or analyzes the cointegration properties of government revenues and expenditures (see e.g. Trehan and Walsh, 1988, 1991; Wilcox, 1989; Hakkio and Rush, 1991; Quintos, 1995 for seminal papers in this literature). The latter approach underlines some limitations of unit root regressions, and focuses on the response of government primary surpluses to the debt-GDP ratio in order to establish if the intertemporal budget constraint is satisfied (Bohn, 1998; 2007).

The issue of fiscal sustainability has been widely explored in the literature and, in more recent years, a large bulk of this research concentrated on European countries for a twofold order of reasons.

As regards more advanced economies, empirical work has been stimulated by the European sovereign debt crisis, in the aftermath of the 2007-2008 US financial crisis. This crisis generated extreme financial pressures on South European economies (Italy, Greece, Spain and Portugal), with large spillover effects raising serious risks for the survival of the whole Eurozone. The available evidence points out the fiscal deficits in these countries are weakly sustainable in the

long run, implying that they might face difficulties in financing their future debts (Trachanas and Katrakilidis, 2013). This result is corroborated by complementary research departing from standard cointegration tests and exploring the sustainability of public debt in the context of Europe's fiscal policy rules (Collignon, 2012).

A parallel strand of literature has explored the sustainability of public finances in Central and Eastern European countries (CEEC). These countries are new members of the European Union (EU), and most of them plan to join the European Monetary Union (EMU) in the near future. Applied work on CEEC is thus strongly motivated by their economic and political agenda, since the fulfillment of fiscal sustainability criteria introduced in the Maastricht Treaty and in the Stability and Growth Pact is crucial in order to evaluate the eligibility of these countries for EMU.

The empirical evidence for CEEC is highly variegated. Applied work relying on the cointegration approach has recently produced favorable results. Using panel cointegration tests on a sample of eight EU new member states (Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Poland, Slovakia and Slovenia), Llorca and Redzepagic (2008) find that public expenditures and revenues are cointegrated, implying that fiscal policies are sustainable in the long run. However, applied work relying on fiscal reaction functions offers a less positive and more complex picture, documenting that primary surpluses react as expected to changes in debt in some countries, but in a destabilizing way in others (Redzepagic and Llorca, 2007; Stoian and Campeanu, 2010).

This paper reassesses the sustainability of public finances in Poland, focusing on the last sixteen years which have been characterized by the end of the macroeconomic stabilization phase following the demise of the communist regime, and by the implementation of several structural reforms.

Poland represents a relevant case-study for various reasons. This country plays a strategic role inside the group of CEEC, given its large weight in terms of population and nominal GDP. Moreover, this country has been one of the first to start the transition process to a market economy in 1989, and is commonly recognized as an outstanding example of successful reformer.

As underlined in Budina and Van Wijnbergen (1997), unsustainable fiscal deficits have represented a major obstacle to macroeconomic stabilization in post-communist economies during the initial stage of economic reforms. Notwithstanding a sharp reduction of the tax base, typical of the earlier transition phase to capitalism, Poland was able to implement a drastic and timely fiscal adjustment which, differently from other transition economies, eradicated the fiscal roots of the inflation process and ensured a steady growth process in subsequent years.

The last decade witnessed a continuing process of real convergence, particularly after Poland's entry in the EU in 2004. According to OECD data, the percentage gap in GDP *per capita* shrank from 58% in 1999 to 49% in 2008, mostly as a result of a significant increase in labor productivity (see Kierzenkowski, 2010, p.14).

Given this successful transition to a market economy, the Euro adoption is currently an essential priority for Poland, although official authorities have never formally committed to a specific date. In this context, a quantitative re-assessment of the sustainability of Polish fiscal policy represents an interesting research topic.

The outline of the paper is as follows. Section 2 reviews previous research. Section 3 discusses the empirical evidence. After a short description of the data base and a preliminary data inspection, the results from various cointegration tests are presented, emphasizing the distinction between a “weakly” and a “strongly” sustainable fiscal policy put forward in Quintos (1995). The causal relationship between government revenues and expenditures is then explored inside a vector error correction framework. Section 4 concludes the paper, summarizing the main results and outlining their policy implications.

## 2. LITERATURE OVERVIEW

Notwithstanding the prominent role of Poland among European transition economies, the literature testing fiscal sustainability in this country is relatively scant. To the best of my knowledge, only three contributions have directly focused on this issue<sup>1</sup>.

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<sup>1</sup> In a more recent paper, Afonso and Rault (2015) analyze the sustainability of public finances for a large sample of EU countries encompassing the new members joining the EU after the May 2004 enlargement. This paper implements a multi-step approach through unit root and panel cointegration tests. However, since the ratios of government revenues and expenditures to GDP turn out to be stationary for Poland, this country is excluded from cointegration analysis.

Green *et al.* (2001) analyze the immediate years after Poland's transition to a market economy, using monthly data from 1991 to 1998. Standard cointegration tests point out that fiscal policy is consistent with the intertemporal budget constraint. Moreover, this paper finds that the fiscal regime is expenditure-led, namely that tax revenues adjust to the planned level of expenditures. These results, however, should be treated with some caution, since this paper explores the existence of a long run relationship between fiscal variables using high-frequency data and a relatively short time span.

Mackiewicz and Krajewski (2009) extend the analysis up to the first half of the last decade, using the alternative testing framework proposed in Bohn (1998). The estimates of fiscal reaction functions reveal that the primary surplus positively responds to lagged increases in public debt, thus supporting the fiscal sustainability condition. However, this paper documents the existence of a strong asymmetric reaction, with all the adjustment to fiscal imbalances coming from the revenue side, while public expenditures are virtually unaffected. Since fiscal consolidations relying on tax increases are unlikely to exert a long lasting effect on deficit (Alesina *et al.*, 1998), the authors conclude that

“the present fiscal institutions in Poland are only conditionally sustainable, and the mechanism that ensured sustainability was weak” (Mackiewicz and Krajewski, 2009, p.455).

Silvestrini (2010) implements a cointegration approach using monthly data from 1997 to 2007. A distinctive feature of this paper is the use of both a classical and a Bayesian approach to make inferences about the cointegrating vector. The main results fully support those reached in the previous literature: government revenues and expenditures are found to be cointegrated, while expenditures are weakly exogenous inside the cointegrating relationship. On average, moreover, expenditures grow slightly faster than revenues. This paper significantly contributes to the literature, since the Bayesian posterior analysis of the cointegrating vector is based on a very efficient deterministic integration method. However, in line with previous research relying on a cointegration framework, the empirical findings should be treated with some caution given the relatively small dimension of the sample period.

On the whole, this literature provides a rather favorable outlook about the sustainability of Poland's public finances. At the same time, however, this research documents some perspective

risks related to a structural difficulty in controlling public expenditures and to the existence of a persistent positive gap between expenditures and revenues.

A major drawback of applied work relying on a cointegration framework is that it examines very short time horizons, thus precluding to draw robust inferences about the long run equilibrium properties of the macrovariables involved.

A further problem is that existing research focuses exclusively on earlier transition years to a market economy. However, notwithstanding some major improvements in Poland's fiscal position in this period, several signs of fiscal distress are present during more recent years.

As underlined in OECD (2006), Poland's public expenditure is not well controlled and, despite an important reform of the pension system, population ageing is expected to put new upward pressures on spending. Further pressures on public expenditures come from the level of social transfers, which is particularly high in Poland with respect to the average of OECD countries (OECD, 2006, fig. 3.5), and from the high level of public sector wages (OECD (2006), fig. 3.8). The level of social contributions required to finance social transfers has created a tax wedge which is one of the highest among OECD countries, with negative effects in terms of employment and job creation (OECD, 2006, figures 3.9 - 3.10).

The above discussion makes clear why an extension of the analysis up to the first half of the current decade is important in order to implement a proper re-assessment about the sustainability of Polish public finances.

The next section addresses this issue, using cointegration techniques allowing to evaluate the degree of fiscal sustainability in the presence of potential structural breaks in the equilibrium relationship between fiscal variables.

### 3. EMPIRICAL EVIDENCE

#### *3.1 Data Set and Preliminary Data Inspection*

The fiscal variables used are total general government expenditures (inclusive of interest payments) and total general government revenues. Both series are expressed in real terms

through the GDP deflator. All series are extracted from Thomson Reuters - Datastream and are expressed on a quarterly basis<sup>2</sup>.

The selection of the sample period is dictated by data availability, and the data set includes quarterly observations from 1999.4 to 2015.2.

The length of this sample is larger than that currently employed in existing applied work, which never extends beyond one decade (Green *et al.*, 2001; Silvestrini, 2010). Moreover, while earlier research relies on monthly data, the present paper employs lower frequency observations.

This research strategy represents a significant improvement on the existing literature. Actually, it is widely known that a wider sample length is important in order to obtain more accurate inferences from cointegration analysis, while the gain in degrees of freedom provided by higher frequency data is more apparent than real since cointegration is a long run equilibrium concept (Hakkio and Rush, 1991b).

Figure 1 plots Poland's real government expenditures and revenues (expressed in logs) from 1999.4 to 2015.2.

Overall, this figure documents rather close co-movements between the series, although the intensity of this relationship decreases towards the end of the sample. Since 2013 onwards, the co-movement between expenditures and revenues is actually much weaker. This possibly reflects the fiscal slippage occurred during 2013 in Poland, as a result of lower than expected tax revenues due to the sharp economic slowdown, and of higher social expenditure and public consumption (OECD (2014), p.24).

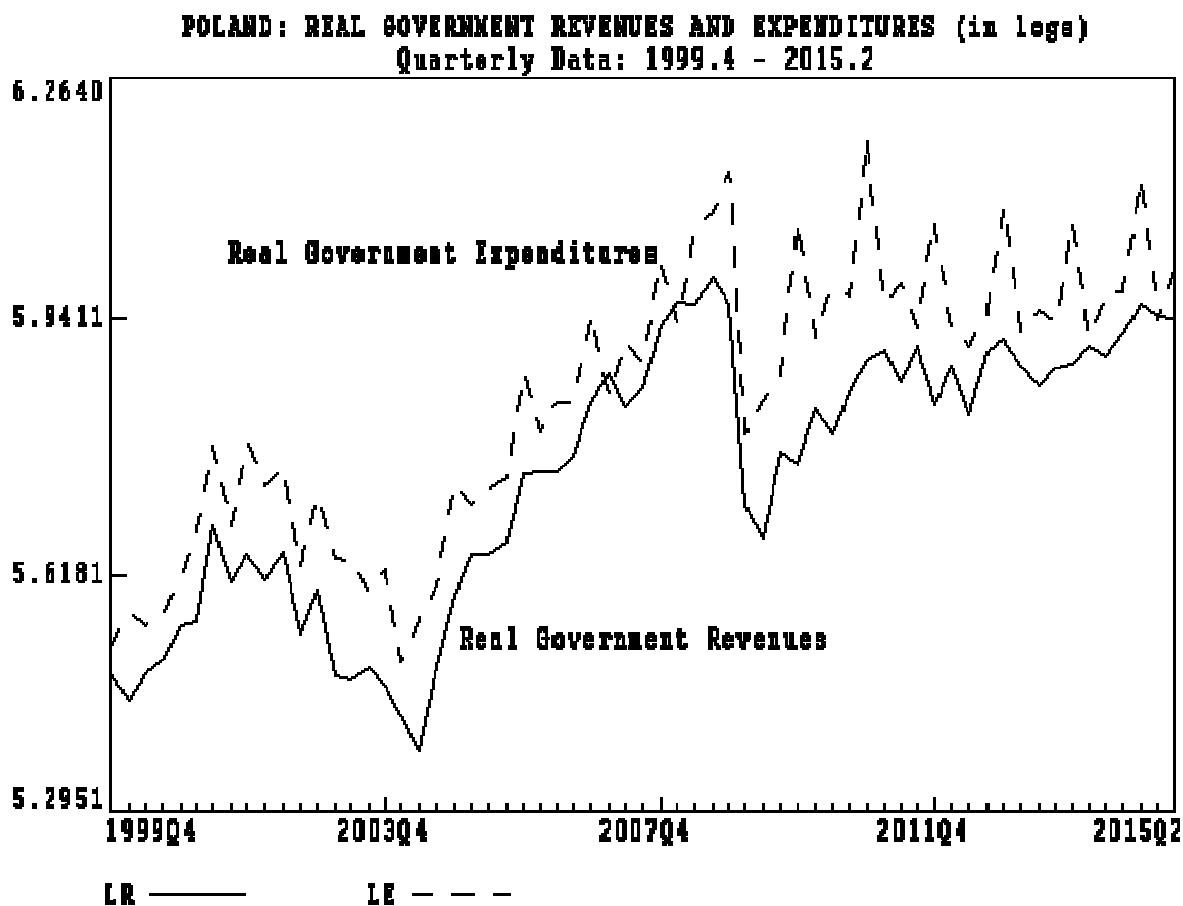
This evidence suggests that the likelihood of a potential structural break in the long run equilibrium relationship between expenditures and revenues should be properly accounted for in this empirical investigation.

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<sup>2</sup> The exact definition of these series is the following: Poland - Total General Government Expenditures, current prices (mio. Euros); Eurostat, code: POES6RPDA; Poland - Total General Government Revenues, current prices (mio. Euros); Eurostat, code: POESAYA6A; Poland - GDP Deflator (2010 = 100), OECD-MEI, code: POQNA057E.

A further relevant feature emerging from Figure 1 is a tendency of expenditures to consistently exceed revenues, in line with an important empirical regularity documented in previous research.

FIGURE 1



Cointegration tests implemented in the next sub-section require a preliminary investigation about the stochastic properties of individual series. Real revenues and expenditures data were therefore submitted to standard unit root tests, namely the ADF test, the KPSS test (Kwiatkowski *et al.*, 1992), the Zivot-Andrews test (Zivot and Andrews, 2002), and the DF-GLS test (Elliot *et al.*, 1996).



Overall, these tests provide overwhelming evidence that these fiscal variables are integrated of order one (I(1)), thus allowing to implement a cointegration-based approach<sup>3</sup>.

### 3.2 Cointegration Tests

This section applies a cointegration-based approach to explore the sustainability of Poland's fiscal policy.

As discussed in the literature, this approach relies on two main assumptions: (1) real government revenues and real government expenditures are non-stationary processes; (2) the real interest rate is a stationary process.

As shown in section 3.1, the former assumption is strongly supported inside the present data set. As regards the latter assumption, recent evidence for both industrial and developing countries strongly supports real interest rates stationarity, once potential structural changes in real interest rates dynamics are accounted for (Rapach and Weber, 2008).

If both the above conditions hold, and if the limiting term in the government's intertemporal budget constraint is zero (thus ruling out the existence of Ponzi schemes to finance the government deficit), the sustainability of the deficit process can be assessed through the following regression equation (see, among others, Hakkio and Rush, 1991, section 2):

$$R_t = a + bE_t + \varepsilon_t \quad (1)$$

where  $R_t$  denotes real government revenues,  $E_t$  denotes real government expenditures (inclusive of interest payments on public debt),  $a$  and  $b$  are parameters, and  $\varepsilon_t$  is a random disturbance term.

Inside this regression framework, the existence of cointegration between  $R_t$  and  $E_t$  is a necessary condition for the government's intertemporal budget constraint to be satisfied. Moreover, the estimate of the  $b$  parameter deserves a particular attention. As formally shown in Hakkio and Rush (1991), the limit term in the government's intertemporal budget constraint is equal to zero as long as  $0 < b < 1$ . However, whenever  $b < 1$ , i.e. as long as expenditures consistently exceed

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<sup>3</sup> Details about the results of these tests are not reported in order to save space, and are available by the author upon request.

revenues, the incentive for the government to default gets larger and the government will experience increasing difficulty in marketing its debt.

This taken into account, the present section tests for cointegration between  $R_t$  and  $E_t$  using various econometric techniques. The next section focuses instead on the empirical estimates of the  $b$  parameter, drawing on the distinction between “weak” and “strong” fiscal sustainability introduced in Quintos (1995).

#### *(a) Standard Cointegration Tests*

I start applying two standard methodologies, namely the Engle and Granger (1987) approach and the Johansen (1995) cointegrating VAR framework.

An ADF test on residuals from the OLS estimate of equation (1) yields a value of -3.09. This statistic rejects the null of absence of cointegration only at a 10% level, while not rejecting the null at more conservative critical values of 5% or 1%<sup>4</sup>. The results from the Engle and Granger (1987) approach are thus basically inconclusive.

A cointegrating VAR on real revenues and real expenditures yields a value of 6.86 for the Maximum Eigenvalue test, and a value of 9.86 for the Trace Test<sup>5</sup>. Both statistics are notably lower than their respective critical values, thus not allowing to reject the null hypothesis of absence of cointegration. The Johansen (1995) approach, therefore, rejects the existence of a long-run equilibrium relationship between fiscal variables.

Overall, this evidence from standard cointegration techniques is at odds with the results achieved in the previous literature (see section 2), and raises some doubts about the existence of a sustainable fiscal policy in Poland during the latest years.

These empirical findings must however be considered with extreme caution. If the equilibrium relationship under investigation exhibits a structural break, conventional cointegrating

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<sup>4</sup> Equation (1) is estimated on a sample of 63 observations. The critical values of the ADF test for a sample of 50 observations are: -4.12 (1%), -3.29 (5%), -2.90 (10%). See Engle and Yoo (1987), Table 3. The auxiliary regression used to generate the ADF statistic includes six lags, as suggested by standard model selection criteria.

<sup>5</sup> The estimated model assumes restricted intercepts and no trends in the VAR. The main results, however, are robust to alternative specifications of the cointegrating VAR. An optimal VAR order of  $p^* = 5$  is selected on the basis of Akaike and Schwarz information criteria and of likelihood ratio tests of VAR(p) against higher order VAR systems. Standard diagnostic tests on residuals of individual equations exclude the existence of serial correlation and heteroscedasticity. A rejection of the normality assumption is detected in the VAR equation normalized on real revenues.

procedures may lead to erroneous inferences, as extensively discussed in the literature (see, e.g. Gregory and Hansen, 1996; Gabriel *et al.*, 2002; Maki, 2012). More specifically, this literature points out that standard residual-based tests suffer from significant power losses when structural breaks are present, tending not to reject the null of no cointegration in favor of the alternative of a stable cointegrating relationship. Since standard cointegration tests are misspecified in the presence of structural breaks, new econometric techniques, robust to regime-shifts in the cointegrating vector, have recently been proposed. These methodologies are designed to account for one regime-shift in the long run equilibrium relationship (Gregory and Hansen, 1996, or even for multiple regime-shifts Hatemi, 2008; Gabriel *et al.*, 2002; Maki, 2012).

The existence of a structural break in the long run equilibrium relationship must be seriously addressed in the context of the present investigation.

As discussed in section 3.1, visual data inspection suggests that co-movements between real revenues and real expenditures are not stable over time, while the intensity of this relationship is apparently much looser along the final part of the sample. This negative trend is documented in influential official documents, which point out a significant deterioration of Poland's fiscal position in 2013 and the need to strengthen fiscal consolidation efforts in various directions (OECD, 2014).

Since the recent fiscal outlook in Poland suggests the likelihood of a structural break, the evidence from standard cointegration approaches needs to be complemented with further investigation.

I therefore resort to the tests developed in Gregory and Hansen (1996) which are robust to a one-time shift in the cointegrating vector.

#### *(b) Cointegration Tests with Structural Breaks*

Cointegration tests developed in Gregory and Hansen (1996) are suitable in the present context, where visual data inspection suggests the existence of only one break in the equilibrium relationship. In this econometric framework, the null hypothesis of absence of cointegration is tested against the alternative of cointegration in the presence of one structural break.

In order to model structural change, the following dummy variable is introduced:

$$D_{t\tau} = 0 \text{ for } t \leq \tau T$$

$$D_{t\tau} = 1 \text{ for } t > \tau T$$

where  $T$  is the sample size and  $\tau \in (0,1)$  is an unknown parameter denoting the timing of the structural break.

Gregory and Hansen (1996) assume three possible types of break in the cointegrating equation corresponding respectively to a level shift, a level shift in the presence of a time trend, and a shift both in the intercept and in the slope of the equilibrium relationship.

In the present investigation, these structural breaks may be formalized as follows:

Model 1: Level shift (C)

$$R_t = \mu_1 + \mu_2 D_{t\tau} + \alpha E_t + \varepsilon_t \quad (2)$$

Model 2: Level shift with trend (C/T)

$$R_t = \mu_1 + \mu_2 D_{t\tau} + \beta t + \alpha E_t + \varepsilon_t \quad (3)$$

Model 3: Regime shift (C/S)

$$R_t = \mu_1 + \mu_2 D_{t\tau} + \alpha_1 E_t + \alpha_2 E_t D_{t\tau} + \varepsilon_t \quad (4)$$

where  $t$  is a linear time trend ( $t = 1, \dots, T$ ),  $D_{t\tau}$  is the dummy variable defined above, and  $\varepsilon_t$  is a disturbance term. Moreover, in line with previous notation,  $R_t$  denotes real government revenues and  $E_t$  denotes real government expenditures (inclusive of interest payments on public debt).

This approach involves a recursive estimation of each candidate cointegrating equation, and a corresponding computation of various unit root tests on residuals across all possible break points. The test statistics to assess the existence of cointegration in the presence of a structural break are the smallest values (i.e. the largest negative values) of ADF,  $Z_\alpha$  and  $Z_t$  obtained across each possible break point in a sample of dimension  $T$ , namely:

$$ADF^* = \inf_{\tau \in T} ADF(\tau)$$

$$Z_\alpha^* = \inf_{\tau \in T} Z_\alpha(\tau)$$

$$Z_t^* = \inf_{\tau \in T} Z_t(\tau)$$

Significant values of these statistics make it possible to reject the null hypothesis of absence of cointegration against the alternative hypothesis cointegration in the presence of one regime shift. Asymptotic critical values for  $ADF^*$ ,  $Z_{\alpha}^*$  and  $Z_t^*$ , obtained using simulation methods and the MacKinnon (1991) response surface procedure, are supplied in Gregory and Hansen (1996).

The results are summarized in Table 1.

TABLE 1 - Poland: Cointegration Tests With Regime Shifts (Quarterly Data: 1999Q4 - 2015Q2)

Models	$ADF^*$	$Z_{\alpha}^*$	$Z_t^*$	Breakpoint Date
Model [C]	-2.74 [7]	-109 <sup>***</sup> [7]	-8.98 <sup>***</sup> [7]	2013Q3
Model [C/T]	-2.63 [4]	-81.9 <sup>***</sup> [4]	-7.69 <sup>***</sup> [4]	2013Q4
Model [C/S]	-2.89 [5]	-97.0 <sup>***</sup> [5]	-8.56 <sup>***</sup> [5]	2013Q3

\*\*\* : Significant at 1%.

Number of lags to compute tests statistics in square brackets. Optimal lags selected through RMSE, AIC, PC, SC information criteria.

Approximate asymptotic critical values for regime-shifts models are reported in Gregory and Hansen (1996, p. 109, table 1).

For the case of one explanatory variable ( $m=1$ ), these critical values are as follows:

Model C	$ADF^*$ , $Z_t^*$ : -4.34 (10%); -4.61 (5%); -5.13 (1%) $Z_{\alpha}^*$ : -36.19 (10%); -40.48 (5%); -50.07 (1%)
Model C/T	$ADF^*$ , $Z_t^*$ : -4.72 (10%); -4.99 (5%); -5.45 (1%) $Z_{\alpha}^*$ : -43.22 (10%); -47.96 (5%); -57.28 (1%)
Model C/S	$ADF^*$ , $Z_t^*$ : -4.68 (10%); -4.95 (5%); -5.47 (1%) $Z_{\alpha}^*$ : -41.85 (10%); -47.04 (5%); -57.17 (1%)

The  $ADF^*$  statistic is never statistically significant. However, both  $Z_{\alpha}^*$  and  $Z_t^*$  turn out to be strongly significant under all structural break specifications. More specifically, as shown in the central columns of Table 1, both statistics largely exceed their 1% critical values for all alternative regime-shift models.

The results from this approach provide therefore overwhelming evidence supporting the existence of a long run equilibrium relationship between government revenues and expenditures, once the likelihood of a structural change in the cointegrating vector is properly accounted for.

Moreover, according to the results displayed in Table 1, this structural change may either correspond to a level shift in the equilibrium relationship (models (C) and (C/T)), or it may involve both a level and a slope change in the cointegrating vector (model (C/S)). The empirical investigation carried out in the next sections will therefore allow for alternative structural break specifications.

A final interesting result is related to the timing of the regime shift. As shown in Table 1, the breakpoint date is unambiguously located towards the very end of the sample, either in 2013Q3 (models (C) and (C/S)) or in 2013Q4 (model (C/T)).

This result is fully consistent with previous preliminary data inspection, suggesting a potential structural change in the long run co-movements between fiscal variables in 2013. During this year, Poland experienced a significant deterioration in the overall fiscal position, as witnessed by an unexpected widening of the deficit/GDP ratio to 4.8 % as a result of concomitant adverse economic shocks (OECD, 2014).

Overall, therefore, this section documents that standard cointegration techniques, neglecting the effects of some relevant macroeconomic shocks, are misspecified and fail to detect the existence of a long run equilibrium relationship between fiscal variables. A regime-shift approach reverses instead the above conclusion, and detects the existence of cointegration between Poland's fiscal variables in line with the results obtained in the previous literature.

### 3.3 “Weak” versus “Strong” Fiscal Sustainability

This section focuses on the quantitative estimates of the slope parameter expressing the linear relationship between revenues and expenditures<sup>6</sup>.

As underlined in section 3.2, a value of the slope parameter comprised in the (0, 1) interval does not violate the fiscal sustainability condition, since the limit term in the government intertemporal budget constraint will equal zero (Hakkio and Rush, 1991). However, in such a

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<sup>6</sup> In standard cointegration tests, the slope parameter ( $\beta$ ) measures the relationship between revenues and expenditures (see section 3.2, equation (1)). In cointegration tests with regime shifts, the slope parameter corresponds to ( $\alpha$ ) in the case of level shifts models (C) and (C/T) (see equations (2)-(3)). Finally, in the case of model (C/S), ( $\alpha_1$ ) represents the value of the slope coefficient before the regime shift, while ( $\alpha_2$ ) measures the change in the slope coefficient at the time of the structural break (see equation (4)).

situation, the limit of the undiscounted value of public debt equals infinity, and this represents a relevant destabilizing factor for the overall fiscal outlook.

Building upon this argument, Quintos (1995) introduces a distinction between a “weak” and a “strong” form of sustainability of the deficit process, which underlies the empirical investigation of this section.

According to Quintos (1995), “strong” sustainability holds if revenues and expenditures (inclusive of interest payments) are cointegrated with a cointegrating vector  $[1, -1]$ . In this case, the slope parameter in the cointegrating regression is equal to one and public debt follows a stationary stochastic process.

The looser condition of “weak” fiscal sustainability corresponds instead to the case when revenues and expenditures are cointegrated, but the slope parameter in the cointegrating regression is lower than one. As formally shown in Quintos (1995), although the government intertemporal budget constraint is still satisfied, the bubble term goes to zero at a rate slower than in the “strong” sustainability case, and debt follows a nonstationary process in this situation.

While clarifying that the fiscal deficit may be “weakly” sustainable even in the presence of an  $I(1)$  or mildly explosive debt process<sup>7</sup>, the macroeconomic and policy implications outlined in Quintos (1995) are similar to those described in the previous literature (see e.g. Kremers 1988, 1989; Hakkio and Rush, 1991). More specifically, if the slope parameter is lower than one (i.e. if expenditures exceed revenues on average), the government will experience greater incentives to default due to increasing difficulties in marketing its debt in the long run.

The analysis performed in section 3.2 shows that a standard cointegration framework fails to detect the existence of cointegration. On the other hand, I document the existence of a cointegrating relationship between fiscal variables in the presence of a significant structural break in 2013.

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<sup>7</sup> “Weak” fiscal sustainability requires, however, that the growth rate of debt does not exceed the growth rate of the economy, and that the growth rate of debt is lower than the growth rate of mean interest rates (see Quintos, 1995, p. 410).

In the light of this evidence, the estimates of the slope parameter rely on the alternative econometric specifications of regime-shifts models, namely: a level-shift (model (C)), a level-shift in the presence of a time trend (model (C/T)), a level-shift and a slope-shift (model (C/S)).

Since an accurate estimate of the slope parameter is crucial in order to discriminate between “weak” versus “strong” fiscal sustainability, all regime-shifts models are estimated using different methodologies. More specifically, besides the standard OLS estimator, I use the dynamic OLS (DOLS) estimator developed in Stock and Watson (1993), and the fully-modified OLS (FM-OLS) estimator proposed in Phillips and Hansen (1990).

It is well known that, although OLS estimates are super-consistent, they are not asymptotically efficient. As emphasized in the literature, OLS estimates are negatively affected by the presence of endogenous I(1) regressors and residuals serial correlation. Therefore, even in the presence of cointegration, these estimates will suffer from small-sample bias and the estimators’ limiting distribution will be non-normal and shifted away from the true parameters (Stock, 1987).

In contrast with the OLS approach, the DOLS and FM-OLS estimators are asymptotically efficient and yield covariance matrices appropriate for inference. These alternative estimators are therefore suitable in the present context, where it is important to get accurate estimates of the slope parameter(s) (i.e. the  $(\alpha)$  parameter in models (C) and (C/T), and the  $(\alpha_1)$  and  $(\alpha_2)$  parameters in model (C/S)).

The DOLS approach proposed in Stock and Watson (1993) is computationally simple, generates asymptotically efficient estimates, and performs relatively well in small samples with respect to similar estimators. The DOLS methodology involves augmenting the cointegrating equation with leads and lags of the first difference of the regressor(s) (i.e., in our case, leads and lags of changes in real expenditures). This procedure ensures robust statistical inference, since the inclusion of leads and lags accounts for possible simultaneity bias and small sample bias among the regressors.

The FM-OLS approach proposed in Phillips and Hansen (1990) implements a semi-parametric correction on the dependent variable by means of a transformation involving the long-run variance-covariance matrix of residuals. This procedure accounts for serial correlation effects and for the endogeneity in the regressors, and yields unbiased estimates of the long-run



relationship and t-statistics which are asymptotically normal. As shown in Hargreaves (1994), the FM-OLS estimator is a fully efficient method of estimating economic equilibrium relationships in small samples.

As regards the DOLS estimates, given the small sample size, I started with four leads and lags ( $q = 4$ ), in line with the approach suggested in Stock and Watson (1993)<sup>8</sup>. The number of leads/lags was then progressively reduced applying variable deletion tests and the Akaike and Schwarz model selection criteria. On this basis, all DOLS estimates for various structural break models are carried out setting  $q = 1$ .

The FM-OLS estimates are obtained using Parzen weights with truncation lag  $k = 8$ . For all structural break specifications, these results are robust to higher lag structures and alternative weighting schemes.

The empirical evidence is summarized in Table 2.

TABLE 2 - Poland: "Weak" versus "Strong" Fiscal Sustainability - Evidence from Alternative Estimators (Quarterly Data: 1999Q4 - 2015Q2)

Alternative Estimators	Model [C]		Model [C/T]		Model [C/S]			
	$\alpha_1$	Wald test: $\alpha_1 = 1$	$\alpha_1$	Wald test: $\alpha_1 = 1$	$\alpha_1$	$\alpha_2$	Wald test: $\alpha_1 = 1$	Wald test: $\alpha_1 + \alpha_2 = 1$
OLS	0.896 (19.2)	4.94** [0.026]	0.783 (10.12)	7.83*** [0.005]	0.910 (20.11)	-0.80 (-2.37)	3.88** [0.049]	7.05*** [0.008]
DOLS	0.975 (24.2)	0.355 [0.551]	0.964 (13.05)	0.227 [0.634]	0.978 (24.4)	-0.347 (-1.23)	0.298 [0.585]	1.70 [0.191]
FM-OLS	0.962 (15.7)	0.382 [0.536]	0.872 (8.05)	1.377 [0.241]	0.968 (16.11)	-1.01 (-2.32)	0.279 [0.597]	5.87** [0.015]

t-statistics in parentheses below estimated parameters values. Marginal significance values for the Wald test in square brackets.

Two (three) asterisks indicate that the Wald statistic is significant at the 5% (1%) level.

The number of leads/lags for DOLS estimates is always set to 1. See the discussion in the main text for the procedure underlying the optimal selection of leads and lags in the estimation of cointegration models with one endogenous structural break.

FM-OLS estimates have been computed using Parzen weights with truncation lag  $k = 8$ .

<sup>8</sup> In order to select the optimal number of leads/lags ( $q$ ), these authors suggest to start the analysis setting  $q = \text{INT}(T^{1/3})$ , where  $T$  is the sample size.

The first line reports the results from the OLS estimator which, as discussed before, I use as a benchmark in comparison with those of other asymptotically efficient estimators. It is interesting to observe that the OLS estimator, besides failing to detect the existence of cointegration (section 3.2 (a)), yields notably smaller point estimates of the slope parameter. This reiterates the importance of using more powerful econometric methodologies.

Focusing on models (C) and (C/T), both the DOLS and the FM-OLS estimators yield point estimates of the slope parameter very close to one, while the Wald test for the null hypothesis that  $\alpha_1 = 1$  is never rejected. This empirical evidence is therefore fully consistent with the existence of “strong” fiscal sustainability.

Model (C/S) produces slightly more mixed results. As shown in the last column of Table 2, the point estimates of the slope parameter before the 2013 breakpoint ( $\alpha_1$ ) are again very close to one, and the Wald test unambiguously supports “strong” fiscal sustainability during this period. However, after the 2013 breakpoint, the change in the slope parameter is not statistically significant according to DOLS estimates, whereas the FM-OLS estimator detects a significant divergence between real revenue and real expenditures. Actually, as shown in the last line of Table 2, the Wald test rejects the null hypothesis that  $\alpha_1 + \alpha_2 = 1$  at a 5% level according to the FM-OLS estimator, thus not supporting the existence of “strong” fiscal sustainability during the whole sample period.

Since all estimated parameters are statistically significant, the FM-OLS estimator is more reliable in the case of model (C/S). Therefore, assuming the existence of a regime-shift both in the constant and in the slope term, “strong” fiscal sustainability holds only up to 2013Q3 but is not supported over the whole sample.

To sum up, the results of this section provide a quite favorable picture about the sustainability of Poland’s fiscal policy during the last fifteen years.

Structural breaks models allowing for a regime-shift in the intercept term support the existence of “strong” fiscal sustainability. However, allowing for a regime-shift both in the constant and in the slope terms of the cointegrating regression, “strong” fiscal sustainability holds only until 2013Q3 but is not supported over the whole sample.

The empirical evidence from model (C/S), which detects “weak” fiscal sustainability over the full sample, is consistent with the recent deterioration of the Poland fiscal outlook highlighted in official documents (OECD, 2014). This result raises some policy implications which will be addressed in the final section.

### *3.4 Causality between Revenues and Expenditures*

Applied work surveyed in section 2 documents a unidirectional causal relationship from expenditures to revenues. This means that expenditures are weakly exogenous in the dynamic relationship between the above variables and supports the so-called “Spend and Tax” hypothesis put forward in the theoretical literature (Barro, 1979).

The causal nexus between revenues and expenditures can however take different forms. Unidirectional causality in the opposite direction, namely from revenues to expenditures (“Tax and Spend” hypothesis) implies that the government adjusts its expenditure programs to the level of its resources; in this situation, the growth of the public sector is strictly constrained by the dynamics of tax revenues (Friedman, 1978). Bi-directional causality, finally, corresponds to the so-called “Fiscal Synchronization” hypothesis, according to which expenditures and revenues are simultaneously selected. In this situation, which corresponds to the classical approach to public finance (Musgrave, 1966), the dynamics of revenues and expenditures is mutually reinforcing<sup>9</sup>.

This section reassesses the causality nexus in Poland’s public finances on the basis of more recent data, and provides some new results which significantly depart from the available evidence.

A careful analysis of the causal relationship between revenues and expenditures has important policy implications whenever the government needs to implement a fiscal consolidation process. If the fiscal system is “expenditure-led”, fiscal consolidation needs to be mainly implemented through a consistent reduction in public expenditures. However, if the causal relationship

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<sup>9</sup> The theoretical literature has also envisaged the case in which expenditure and tax decisions are completely independent due to the institutional separation of the corresponding decision-making centers (Hoover and Sheffrin, 1992). Under these circumstances, no causality pattern exists between revenues and expenditures. This possibility is not explored in the present paper, since the existence of cointegration implies that there always exists a causal relationship between variables at least in one direction (Engle and Granger, 1987).

between revenues and expenditures takes different forms, fiscal consolidation should not exclusively involve the expenditure side. Actually, whenever an increase in the tax burden tends to increase government expenditures, fiscal reforms should also aim at generating a sensible reduction in the overall fiscal pressure. This issue deserves a particular attention, since recent studies point out that the tax level is already too high in Poland, as in many other new EU member countries (Mitra and Stern, 2003; Bernardi and Chandler, 2004).

The analysis carried out in the present section is based on a standard Vector Error Correction Model (VECM) focusing on the dynamic linkages between real revenues and real expenditures. This model can be specified as follows:

$$\Delta R_t = \delta_1 + \gamma_1 \text{RES}_{t-1} + \text{lagged}(\Delta R, \Delta E) + \varepsilon_{1t} \quad (5)$$

$$\Delta E_t = \delta_2 + \gamma_2 \text{RES}_{t-1} + \text{lagged}(\Delta R, \Delta E) + \varepsilon_{2t} \quad (6)$$

where  $\Delta$  is the first-difference operator,  $\gamma_1$ ,  $\gamma_2$ ,  $\delta_1$ ,  $\delta_2$  are parameters,  $\varepsilon_{1t}$  and  $\varepsilon_{2t}$  are white-noise residuals,  $R_t$  and  $E_t$  denote, as before, real government revenues and expenditures, and  $\text{RES}_{t-1}$  is the lagged error correction term.

A major advantage of the VECM specification is that it allows disentangling between different sources of causality related to long and short-run dynamics. The error-correction parameters ( $\gamma_1$ ,  $\gamma_2$ ) provide information about long-run causality. Negative and significant error correction parameters imply that left-hand variables in the corresponding equations of the VECM adjust to eliminate deviations from long-run equilibrium. Inference about short-run causality relies instead on testing the joint significance of lagged variables in each equation.

In line with the previous section, I focus on various regime-shifts models since section 3.2 documents the existence of cointegration between fiscal variables only in the presence of a structural break. The VECM summarized by equations (5)-(6) is applied to each structural break model (i.e. to models (C), (C/T) and (C/S)). The lagged error correction term in each of these VECMs corresponds therefore to the residuals from the cointegrating regression relative to alternative regime-shifts models.

The optimal VECM order ( $p$ ) was selected on the basis of standard Akaike and Schwarz criteria, and of likelihood ratio tests of ( $p$ ) versus ( $p+1$ ) specifications. In all cases, the above procedures

led to select  $p = 3$ . Diagnostic tests pointed out that a VECM(3) specification removes residuals serial correlation and that all VECMs are correctly specified.

Table 3 summarizes the empirical evidence.

TABLE 3 - Poland: Vector Error Correction Models for Real Revenues and Real Expenditures  
(Quarterly Data: 1999Q4 - 2015Q2)

	Model [C]	Model [C/T]	Model [C/S]
$\gamma_1$	-0.80 <sup>***</sup> (-4.04)	-0.775 <sup>***</sup> (-3.90)	-0.749 <sup>***</sup> (-3.78)
$\gamma_2$	-0.699 <sup>***</sup> (-3.23)	-0.668 <sup>***</sup> (-3.08)	-0.655 <sup>***</sup> (-3.04)
Null Hp: Lagged values of $\Delta R=0$ in the equation normalized on $\Delta E$ .	40.12 [.000]	39.19 [.000]	39.00 [.000]
Null Hp: Lagged values of $\Delta E=0$ in the equation normalized on $\Delta R$ .	15.05 [.002]	14.46 [.002]	13.98 [.003]

Estimated VECMs are specified as follows:

$$\Delta R_t = \delta_1 + \gamma_1 \text{RES}_{(t-1)} + \text{lagged}(\Delta R, \Delta E) + \varepsilon_{1t}$$

$$\Delta E_t = \delta_2 + \gamma_2 \text{RES}_{(t-1)} + \text{lagged}(\Delta R, \Delta E) + \varepsilon_{2t}$$

Number in parentheses below estimated parameter values are t-statistics.

Number in square brackets behind Likelihood Ratio tests are marginal significance levels. \*\*\* : significant at the 1% level.

The most salient feature is that the results are highly homogeneous across estimated VECMs. More specifically, under all structural break specifications, both error correction parameters are always negatively signed and highly significant. Moreover, under all regime-shifts specifications, likelihood ratio statistics strongly reject the null hypothesis that coefficients of lagged variables are zero in individual VECM equations.

The former result relative to the error-correction parameters ( $\gamma_1, \gamma_2$ ) documents that no fiscal variable is weakly exogenous, since both real revenues and real expenditures adjust to correct temporary deviations from the long-run equilibrium path. This result strongly supports the “Fiscal Synchronization” hypothesis, namely long-run bi-directional causality between revenues and expenditures.

The latter evidence relative to likelihood ratio statistics can be interpreted as a standard Granger-Sims causality test. Since likelihood ratio statistics consistently reject the null hypothesis at very high significance levels, these results reinforce previous evidence, pointing out the existence of significant short-run bi-directional causality.

Overall, VECMs provide strong support to the existence of bi-directional causality between fiscal variables, documenting that their dynamics is mutually reinforcing both in the short and in the long-run.

It is interesting to observe that these findings stand in sharp contrast with previous literature for Poland, which supported a unidirectional causal link from expenditures to revenues, i.e. the weak exogeneity of public expenditures.

The policy implications of these results will be discussed in the following concluding section.

#### 4. CONCLUDING REMARKS AND POLICY IMPLICATIONS

The objective of joining the Euro area has become a relevant issue in the policy agenda of many European transition economies. In this perspective, achieving a sustainable fiscal process is of paramount importance, since the fulfillment of Maastricht criteria in terms of government deficit and public debt represents an essential prerequisite for a country’s eligibility for EMU participation.

This paper reassesses the sustainability of public finances in Poland, which represents a particularly interesting case study among European emerging market economies. This country has a long lasting history in the implementation of structural reforms, and plays a strategic role among the group of Central and Eastern European countries.

The main contribution to the literature is threefold. First, I use a wider sample with respect to previous research, which usually focuses on shorter periods and does not incorporate data about the current decade. Second, I account for potential structural breaks in the cointegration relationship between government revenues and government expenditures. Third, I reconsider the causality nexus between these variables, providing new results which significantly depart from the available evidence.

The main empirical findings may be summarized as follows.

Standard cointegration tests reject the existence of cointegration. However, cointegration tests allowing for structural breaks detect a long-run equilibrium relationship between real revenues and real expenditures. The regime-shift date is unambiguously located towards the end of the sample when a significant deterioration takes place in Poland's overall fiscal outlook. A closer inspection of estimated parameters reveals that fiscal policy is "strongly" sustainable for most of the sample. However, a model allowing for a regime-shift both in the constant and in the slope of the cointegrating vector reveals that the fiscal process is only "weakly" sustainable considering the whole sample, as a consequence of a significant divergence between revenues and expenditures occurring since the 2013 breakpoint date. Vector Error Correction models add further interesting insights. Differently from previous research, maintaining that Poland's fiscal system is "Expenditure-Led", I find strong support to the existence of a bi-directional causal relationship between revenues and expenditures. The "Spend-and-Tax" hypothesis is thus strongly rejected in the present paper, whereas strong support is provided for the "Fiscal Synchronization" hypothesis, according to which government revenues and expenditures are simultaneously determined.

One important policy implication to be drawn from the above evidence is related to the need of strengthening the ongoing process of fiscal consolidation.

As documented by empirical estimates, the worsening of the fiscal outlook in 2013 has lowered the degree of sustainability of Poland's fiscal policy from "strong" to "weak". Although the intertemporal budget constraint is still satisfied under "weak" sustainability, the persistence of a positive gap between expenditures and revenues may create difficulties for the government in marketing its debt. This, in turn, may lead to a self-fulfilling crisis on public debt, which would significantly delay Poland's process towards joining the Euro area. A major fiscal consolidation

effort represents therefore an important priority for Polish policy-makers, in order to eliminate the current diverging gap between expenditures and revenues.

Important steps in this direction have been made since the beginning of the current decade, when Poland remained one of the EU countries under an excessive deficit procedure and began to introduce permanent fiscal rules in order to strengthen the long-term stability of public finances (see OECD, 2013 for a detailed description of major consolidation measures). However, although past consolidation measures have stabilized the debt-to-GDP ratio, the results of this paper suggest that further fiscal efforts are needed in order to gradually implement a structural deficit reduction consistent with the objective of joining the Euro area in the near future. A reduction in the structural component of the deficit will reinforce Poland's ability to adjust to asymmetric shocks once the country will become an Euro area member. In this perspective, compliance with the July 2009 ECOFIN Council recommendation to lower the general government deficit below 3% represents an essential target for Polish policy-makers.

A further relevant policy implication is related to the composition of the fiscal consolidation process.

The fiscal adjustment measures implemented during the first half of the current decade were mostly based on increased government revenues (see Figure 1.11, p. 51 in OECD, 2013). This approach is broadly similar to that followed by Polish authorities during the previous decade, which has often been characterized by an unbalanced reliance on tax increases (see Mackiewicz and Krajewski, 2009 and the literature overview in section 2).

The empirical evidence of this paper implies that further fiscal consolidation efforts relying on excessive tax increases would be inappropriate in the Polish context. VECM causality tests show that the dynamics of government revenues and expenditures is mutually reinforcing. Therefore, in the current economic environment, excessive reliance on tax revenues risks to put further pressures on the expenditure side, with no significant improvement in terms of the overall fiscal balance.

Poland should thus pursue further fiscal consolidation efforts in the years ahead, but aiming at a more balanced composition of fiscal adjustment measures between tax increases and expenditures reduction.



Since the revenue-to-GDP ratio in Poland is currently higher than the OECD average, there is currently a large consensus among the profession that achieving fiscal sustainability through further increases in the tax burden is not the optimal solution.

The main policy recommendations put forward by international agencies are thus broadly in line with the policy implications of the present paper, and outline a more balanced fiscal mix between government revenues and expenditures.

A key priority is to progressively shift the tax burden from labor and capital to taxes with a less negative impact on economic growth (OECD, 2013). Efficient measures to pursue more medium-term consolidation without adverse supply-side effects include a broadening of the VAT base, eliminating reduced rates and exemptions; increases in property and environmental taxation; further privatizations in competitive segments of the economy (OECD, 2016). On the expenditure side, the recently introduced new fiscal rule, covering the bulk of government expenditures, should enhance the transparency and credibility of the fiscal process through limits on spending increases based on a moving average of GDP growth. Further reduction in government spending should anyway be realized, increasing cost efficiency in the public administration and implementing further reductions in social contribution expenditures and additional changes to the 2014 pension reform (OECD, 2014).

If a credible fiscal consolidation will be implemented along the above guidelines, the structural reduction in the government deficit will not generate adverse effects on real growth, and Poland should soon be ready to relinquish an autonomous monetary and exchange rate policy joining the Euro area in the near future.

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