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Stabilising expenditure rule in Poland – stochastic simulations for 2014-2040

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The stabilising expenditure rule (SER) imposed on general government (GG) sector in Poland has been binding since 2014. According to this rule, about 90% of GG expenditure will grow in line with the real medium-term GDP, or slower if there is excessive debt or deficit, or balance does not meet the medium-term objective. It was shown in this paper how the SER affects the most important public finance indicators in the period 2014-2040. The consequences of the lowered debt thresholds in the SER's correction mechanism due to the pension reform were also presented. Finally, future fiscal policy conducted under the new rule was simulated and assessed.

Keywords: stabilising expenditure rule, stochastic simulations, debt thresholds, fiscal policy cyclicality

JEL codes: C53, E62

Stabilizująca reguła wydatkowa w Polsce – symulacje stochastyczne na lata 2014-2040

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Stabilizująca reguła wydatkowa (SRW) nałożona na sektor instytucji rządowych I samorządowych (GG) w Polsce obowiązuje od 2014 r. Zgodnie z tą regułą, około 90% wydatków sektora GG będzie rosło zgodnie z średniookresowym realnym tempem wzrostu PKB lub wolniej w razie nadmiernego długu lub deficytu albo wyniku poniżej średniookresowego celu budżetowego. W tym artykule, pokazano jak SRW wpłynie na najważniejsze wskaźniki dotyczące finansów publicznych w okresie 2014-2040. Zaprezentowano także skutki obniżonych progów zadłużeniowych w mechanizmie korygującym SRW z powodu reformy emerytalnej. Wreszcie, dokonano symulacji i oceny polityki fiskalnej prowadzonej w przyszłości przy założeniu obowiązywania nowej reguły.

Słowa kluczowe: stabilizująca reguła wydatkowa, symulacje stochastyczne, progi zadłużeniowe, cykliczność polityki fiskalnej

Kody JEL: C53, E62

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1. Introduction

There has been a structural change in the Polish fiscal framework in 2013. The temporary disciplining expenditure rule and the debt threshold of 50% of GDP were replaced by the permanent stabilising expenditure rule. The spending limit, calculated according to the new rule, will be determined validly for the first time in the state budget act for 2015. In addition to that, general government debt in 2014 is expected to decrease from 57.1% down to 49.5% of GDP (Ministry of Finance, 2014), mostly due to the pension system reform. As a consequence, debt thresholds in the correction mechanism of the SER, referring to debt calculated according to the domestic methodology, were also reduced by 7 percentage points (Act revising(…), 2014). The fiscal rule equipped with that mechanism is designed so that not only to reduce and then stabilise public debt below 43% of GDP but also to stabilise nominal balance on average at the medium-term objective level. As public expenditures will grow in principle in line with medium-term real GDP growth, the SER is also expected to make fiscal policy countercyclical (as regards nominal balance) or acyclical (as regards expenditure dynamics). In addition to that, the negative correction, triggered by the imbalance in public finances, will be suspended during bad economic situation, which strengthens the countercyclical character of the rule.

The main aim of this article is to investigate how the new rule will affect sustainability of public finances and countercyclicality of fiscal policy in Poland.

The two aforementioned aspects of fiscal policy: sustainability and countercyclicality are especially desirable after the recent financial crisis. The crisis exposed the fact that fiscal policy in most of EU member states was expansive in good times, so not enough space was left for countercyclical measures in bad times. There is a consensus that Poland is no exception. The Polish Ministry of Finance (2012) admitted that: 'Historic data clearly shows a general government balance with regular excessive deficit, whose level over the last decade has been among the highest in the EU. Therefore, the rules did not prevent the deep imbalance of the public finances. Therefore, further strengthening of the fiscal framework is necessary (...)'.

Jajko (2008) asserted that the lack of public finances sustainability had led to a systematic rise of public debt in spite of restructuring of the foreign debt in the early 90's. Jajko made a remark that the level of public debt had been very seldom an impulse for resolving deteriorating problems at the expenditure side. Among the factors affecting public debt in Poland, she mentioned: interrupted and short-term horizon of the fiscal policy, as well as permanent feature of the fiscal imbalance.

Unsastainability of the Polish public finances was confirmed in the paper prepared by Jędrzejowicz, Kitala and Wronka (2009). 'There is a basis to say that fiscal policy in Poland was procyclical, in particular during the economic revival in the second half of the 90's' As a remedy they recommended to introduce a domestic expenditure rule, because such rules eliminate procyclicality of discretionary fiscal policy.

However, the consensus about instability and procyclicality of the fiscal policy is not fully shared among the Polish economists. The abovementioned findings were undermined e.g. by Mackiewicz (2010) who performed an econometric study over the period 1993-2008. He found that the fiscal policy in Poland had influenced aggregate demand in an countercyclical way, which had mitigated the business cycle. Moreover, the impact of the fiscal policy had exceeded the automatic stabilizers' effect at the revenue side of the state budget. Mackiewicz also confirmed the hypothesis of fiscal sustainability defined as stabilising influence of primary balance on public debt. Both conclusions stand in opposition to those made by the formerly cited economists.

Some methods which appeared in the cited articles were also applied in the following one, but contrary to the mentioned papers, the following one is mostly future-oriented. The following paper concerns also the similar issues as in the note prepared by the IMF (2013). In that note the results of simulations of the Polish economy and the fiscal policy under four variants of expenditure rules were assessed but there was no detailed discussion on the adopted methodology. One crucial reservation should be made here. The modelling approach adopted by the author of this paper focuses on the stabilising impact of the SER on the public finances rather than on macroeconomic fluctuations (though it was not totally ignored).

The former – the necessity to maintain public finances stable is reflected in the thresholds stipulated in the Protocol annexed to the Treaty on European Union (2008): 60% of GDP for debt and 3% for deficit. Besides, one should mention the medium-term budgetary objective (MTO), which constitutes the cornerstone of the revised Stability and Growth Pact – in particular of the Directive on requirements for budgetary frameworks (European Union, 2011a). The SER was designed to be consistent with all these requirements, as well as with the constitutional requirement limiting the national public debt to the level of 60% of GDP.

The latter – the role of fiscal policy in stabilising an economy belongs to the most important battlegrounds in the modern economics. Matczuk (2009) distinguished three episodes in the approach of macroeconomists to this topic: 'the keynesian consensus' (the 30's – 2nd half of the 60's), 'the critique of the stabilising fiscal policy' (2nd half of the 60's – the 70's) and 'looking for the consensus' lasting since 80's. This paper was written according to the third approach, which manifested itself in fixed potential GDP path (neutrality of the fiscal policy in the long run) and dependence of the output gap on the public deficit (non-neutrality in the short run).

The article was organised as follows. In the second chapter the numerical formula and the process of introducing the stabilising expenditure rule into the law were summarized. Chapter 3 treats about simulations of the Polish economy under the SER. Both the deterministic projection and the stochastic simulations were described with regard to: assumptions on data, applied econometric and computational methods and results. Answers for two questions: what is the effect of lowering the debt thresholds and how has the fiscal reaction function changed after introducing the SER, can be found in the fourth chapter. Chapter 5 concludes.

2. Overview of the stabilising expenditure rule

2.1. Basic formula and the correction mechanism

According to formula (1), the *level of expenditure* of the general government sector, without entities which are not able to generate significant deficits and without expenditure fully financed from the EU funds, increases as a rule by the product of medium-term real GDP growth and forecast CPI. It is also multiplied by the correction of CPI forecasts and, finally, forecast of discretionary change in the revenue is added. In general, the GG expenditure growth should be in line with this formula, deviations from which (i.e. corrections) are possible only under strictly specified conditions.

$$EXPEN_n = EXPEN^*_{n-1} \cdot E_n(CPI_n) \cdot [GDP^*_n + C_n] + E_n(\Delta DM_n) \quad (1)$$

Where: X_n – a value of variable X in year n; $E_n(Y)$ – a forecast of variable Y in the draft budgetary act for year n; EXPEN – the *level of expenditure* implied by the SER; EXPEN* - the *level of expenditure* adjusted by inflation forecast errors according to formula (2); CPI – dynamics of the consumer price index; GDP* - forecast real medium-term GDP growth; C – correction implied by the correction mechanism presented in formula (5); ΔDM –discretionary revenue measures in taxes and contributions exceeding 0.03% of GDP.

The adjustment for CPI forecasts errors is developed in equation (2). It consists in updating two forecasts during year n-1 in which the *level of expenditure* is set for year n. Older of the forecasts (for n-2) is replaced by a final outcome, whereas more recent (for n-1) is updated as the information set becomes broader compared to a period one year before. Variable EXPEN* can be interpreted as the *level of expenditure* which should have been determined consistently with the current knowledge of inflation development.

$$EXPEN^*_{n-1} = EXPEN_{n-1} \cdot \frac{CPI_{n-2}}{E_{n-1}(CPI_{n-2})} \cdot \frac{E_n(CPI_{n-1})}{E_{n-1}(CPI_{n-1})} \quad (2)$$

CPI stands for the nominal part, whereas the medium-term GDP growth for the real part of the formula. In order to calculate the medium-term GDP growth based on formula (3), eight years should be taken into account. Six of them are outcomes, while two (n-1 and n) must be forecast (by the Ministry of Finance). According to the statement of reasons of the act introducing the SER (Act revising(…), 2013), eight years were chosen because a maximum standard duration of a business cycle in Poland and advanced economies is estimated at this number (i.e. Gradzewicz et al., 2010, Skrzypczyński, 2010).

$$GDP^*_n = \sqrt[8]{\frac{GDP_{n-2}}{GDP_{n-8}} \cdot E_n\left(\frac{GDP_{n-1}}{GDP_{n-2}}\right) \cdot E_n\left(\frac{GDP_n}{GDP_{n-1}}\right)} \quad (3)$$

Where: GDP – level of GDP in fixed prices.

Unless there is imbalance in the public finances, the aforementioned indicators suffice to calculate the *level of expenditure*. However, the SER contains also the correction mechanism which is described in a compact form in formula (5). The formula can be expressed in writing as follows. In the case of high level of public deficit or debt (over 48% according to the lowered thresholds (Act revising(…), 2014) – see subchapter 4.1 for details or 3% of GDP respectively), the stronger correction (2 pp deducted from the medium GDP real growth) is triggered regardless of the forecast economic situation. Here public debt is identified as net of financial resources allocated to fund borrowing needs, while deficit is adjusted for pension reform costs.

Otherwise, if public debt exceeds 43% of GDP, the normal correction (1.5 pp deducted from the medium-term GDP real growth is triggered, unless severe economic downturn is projected (forecast GDP growth lower than medium-term one by more than 2 pp, i.e. the so called 'bad times').

Otherwise, the possible correction depends on sum of cumulated differences between the nominal balance and the MTO (medium-term objective) which is abbreviated to the *sum of differences* (see formula (4)). The aim of this debt-brake mechanism is to temporarily decrease (increase) the expenditure growth limit below (over) the medium-term GDP growth until the excessive deviations from the target are absorbed, in order to secure long-term stability of public finances. It is important that the correction mechanism is automatic and precisely determines the type of correction. If the cumulated deviations breach -6% (+6%) of GDP, then the negative (positive) correction is applied respectively. An exception to this rule occurs during above-mentioned 'bad times', when negative correction is suspended and 'good times' (forecast GDP growth higher than medium-term one by more than 2 pp), when the same happens to positive correction.

$$SoD_n = SoD_{n-1} + NB_n - MTO_n \tag{4}$$

Where:
SoD – *sum of differences* between a nominal balance and the MTO; MTO – medium term objective, determined at the level of -1% of GDP.

$$C_n = \begin{cases} -2\text{ pp}, & NB^*_{n-2} < -3\% \text{ of GDP or } D_{n-2} > 48\% \text{ of GDP} \\ -1{,}5\text{ pp}, & \begin{cases} NB^*_{n-2} \geq -3\% \text{ of GDP and } D_{n-2} \in (43\% \text{ of GDP, } 48 \text{ of GDP}] \\ E_{n\text{-}1}(GDP_n) \geq GDP^*_n \text{ - 2 pp} \end{cases} \\ -1{,}5\text{ pp}, & \begin{cases} NB^*_{n-2} \geq -3\% \text{ of GDP and } D_{n-2} \leq 43\% \text{ of GDP} \\ SoD_{n-2} < -6\% \text{ of GDP} \\ E_{n\text{-}1}(GDP_n) \geq GDP^*_n \text{ - 2 pp} \end{cases} \\ +1{,}5\text{ pp}, & \begin{cases} NB^*_{n-2} \geq -3\% \text{ of GDP and } D_{n-2} \leq 43\% \text{ of GDP} \\ SoD_{n-2} > 6\% \text{ of GDP} \\ E_{n\text{-}1}(GDP_n) \leq GDP^*_n + 2\text{ pp} \end{cases} \\ 0, & \text{in other cases} \end{cases} \tag{5}$$

Where:

NB* – nominal balance adjusted for the pension reform costs; D – public debt calculated according to the domestic methodology net of financial resources assigning for financing borrowing needs .

It is also worth adding that in the case of the SER, only one debt calculating method is applied, i.e. using the average exchange rate of foreign currencies to zloty and deducting the value of liquid funds designed to finance borrowing needs for the next year. In the SER, the traditional debt calculating method is not taken into consideration at all. This stands in contrast with the thresholds binding since 1998, in the case of which both methods must indicate a breach before sanctions are triggered.

Finally, escape clauses are foreseen only in the case of martial law or a state of emergency or natural disaster in the whole territory of the Republic of Poland. Such an escape clause will allow for setting the limit at a level unrelated to the SER indication.

2.2. Historical background

First announcement of government's intentions to introduce a new fiscal rule appeared in *Plan for the Development and Consolidation of Finances 2010-2011* (Ministry of Finance, 2010, p. 9-10) at the very beginning of the document consisting of then priorities of the Government. An objective of that rule was to reduce and subsequently stabilise the structural deficit at the level of the medium-term objective (1% of GDP). In contrast, as it was explained in subchapter 2.1, the implemented SER will target the nominal balance rather than the structural one (see subchapter 2.3 for details).

In the *Plan for the Development…* two fiscal rules were announced, though the subchapter was entitled 'Introducing a fiscal rule'. The first one was described as temporary, responsible for reducing a deficit, while the second one – as stabilising deficit at the new level. Although both rules referred to a structural deficit, it was stated in the document: 'The crucial element of the above-cited solutions is implementation of binding expenditure rules (temporary and permanent)'. However, an expenditure rule *ex definitione* is not the optimal tool to target a structural deficit.

Basically, the announcements concerning fiscal rules revealed in the Plan for the Development… were implemented. The disciplining expenditure rule, which limited real growth of specific budgetary expenditure to 1%, constituted the first, temporary rule. It was suspended and abrogated in 2013, before reducing the structural deficit down to 1% of GDP. This is to be achieved by the second, permanent rule, i.e. stabilising expenditure rule.

The concept of the stabilising expenditure rule evolved over time. In the Convergence Programme, update 2011 (Ministry of Finance 2011), the permanent fiscal rule was to "ensure, after the previous deficit reduction, that the general government balance is on average stable at the MTO level over the cycle". A year later (Ministry of Finance 2012), the mechanism, triggering correction in case of excessive cumulated deviations of the nominal balance from the MTO, and the coverage (the general government sector excluding the local governments and expenditure financed from non-refundable EU grants) were described for the first time.

Finally, in the 2013 update (Ministry of Finance, 2013a) many details on the SER were revealed. Firstly, a distinction on the wider *level of expenditure* (at that time called "limit") and the narrower limit (at that time called "sublimit") was made. The *level of expenditure* was to be imposed on the general government sector with the exception of: expenditure financed from non-refundable EU grants and expenditure of those units which are obliged to balance their budget plan. The *level of expenditure* was to be calculated according to the formula, while the limit could be obtained by deducting the forecast level of expenditure of: local governments, the National Health Fund and the entities referred to in Article 139(2) of the Public Finance Act. Secondly, final forms of some components of the formula were not yet chosen. For instance, there was no decision about the nominal component, as well as on the correction mechanism.

The draft assumptions to the draft Act revising the Public Finance Act were prepared on 6th June 2013. The SER was based on the average real GDP growth over 8-year period which was consistent with the announcements. It also covered possibly wide range of the general government sector. On the other hand, its nominal component is CPI inflation instead of inflation target of the central bank which was mentioned in the document. Some elements of the formula were still presented in the variant form. The correction was to be expressed in percentage points or percent of GDP. Besides, the two components in the formula: adjustment for inflation forecast errors and discretionary change in structural revenue were not approved. However, the most crucial decision which was made only partially at that stage concerned the correction mechanism. Three thresholds: deficit-to-GDP ratio amounting to 3% (calculated according to the ESA methodology) and debt-to-GDP ratios amounting to 50% and 55% (calculated according to the domestic methodology) were determined. The first variant of the remaining part of the correction system was based on a sum of differences between the nominal balance and the MTO, while the second one used another debt-to-GDP threshold, this time amounting to 40%.

On 16th July the assumptions to the draft Act have been adopted by the Council of Ministers. All of the remaining questions were addressed. The correction was expressed in percentage points; both: adjustment for inflation forecast errors and discretionary change in structural revenue appeared in the formula; while the correction mechanism included cumulated deviations of the nominal balance from the MTO. On 1st October the draft Act has been adopted by the Council of Ministers. Lower chamber of parliament (Sejm) accepted the draft act on 8th November, while upper house (Senat) adopted the bill on 5th December. Finally, the President signed the act (Act revising(…), 2013) on 23rd December. The stabilising expenditure rule came into force 28th December 2013.

The debt thresholds stipulated in the act introducing the SER referred primarily (Act revising(…), 2013) to 50% (the weaker correction) and 55% of GDP (the stronger correction). Due to the pension system reform, thanks to which the debt-to-GDP ratio sharply declined, both thresholds were lowered by 7 pp to: 43% and 48%. The respective draft act (Act revising(…), 2014) was adopted by the Council of Ministers on 25th February 2014, by the Lower Chamber of Parliament (Sejm) on 9th May and by the Higher Chamber of Parliament (Senat) on 6th June. The act was finally signed by the President of Poland on 30th June 2014 and came into force next day.

In order to confirm the announced countercyclical character of the SER, simulations and statistical analysis were conducted and described in chapters 3-4. The real component in the formula (see chapter 2.1) gives strong presumption about the acyclicality rather than countercyclicality in regard to expenditure dynamics. However, nominal balance implied by the SER should form in a countercyclical manner.

2.3. Relationship between the structural and the nominal balance

In this part of the paper, there is clarification of two issues outlined in the previous subchapter. Both refer to the possible consequences of targeting the nominal balance at the MTO level. The first question is: what will be the mean structural balance? The second one is: how often will the nominal deficit breach 3% of GDP?

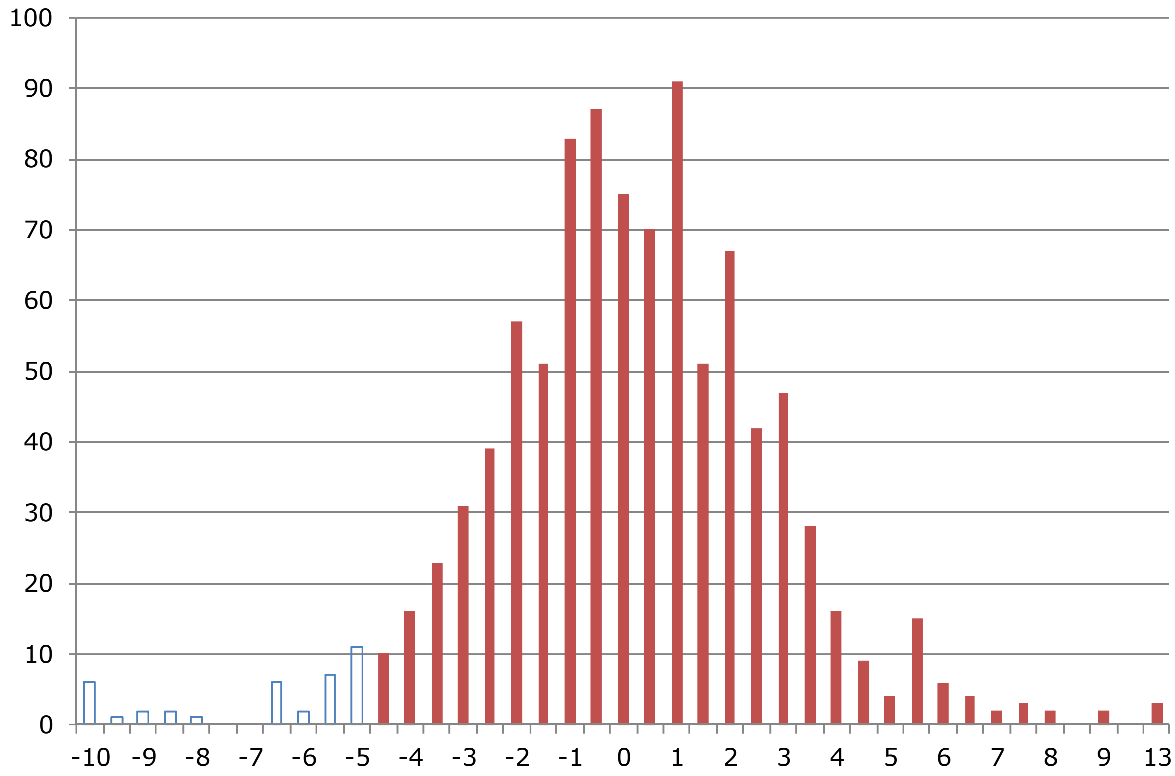
Firstly, assuming regularity in business cycles and zero expected value of one-offs, mean structural balance over the cycle equals the respective measure for a balance expressed in nominal terms. That results from the fact that a sum of cyclical components of budget balance amounts to zero if mean output gap also equals zero, while the cyclical component is a linear function of an output gap. Hence, if a sum of cyclical components amounts to zero, then a sum of structural components stands for a sum of nominal balances. Dividing both sums by number of observations is the last step to prove identity between mean structural balance and mean nominal balance.

$$\frac{\sum_{i=1}^{n} StrBal_i}{n} = \frac{\sum_{i=1}^{n} Bal_i + \left(OG_i \cdot El_{OG}^{B}\right) + OOs_i}{n} = \frac{\sum_{i=1}^{n} Bal_i}{n} + \frac{El_{OG}^{B}\sum_{i=1}^{n} OG_i}{n} + \frac{\sum_{i=1}^{n} OOs_i}{n} = \frac{\sum_{i=1}^{n} Bal_i}{n} \qquad (6)$$

Secondly, according to the regulation on the strengthening of the surveillance of budgetary positions (European Union, 2011b), as well as *Plan for the Development…*, maintaining structural deficit at the level of 1% of GDP prevents from exceeding 3%-of-GDP threshold by nominal deficit ("provides for a safety margin to ensure the avoidance of an excessive deficit"). From the statistical point of view, this sentence turns out to be not fully correct. It may happen on average once per 25 years that nominal deficit exceeds 3% of GDP even if structural balance is hold at the MTO level. The way of reasoning is as follows.

As one can see in formula (6), structural balance consists of three components: nominal balance, cyclical component and one-offs. One-offs were skipped in further analysis, as they are difficult to predict and usually insignificant or of lesser magnitude than other components. Therefore, in order not to violate the 3%-of-GDP threshold for nominal deficit stipulated in the Stability and Growth Pact, one must keep 1%-of-GDP structural deficit and cyclical deficit lower than 2% of GDP. Now it is worth referring to the methodology applied by the European Commission (EC). To calculate cyclical component, the EC multiplies output gap by semi-elasticity for budget balance which for Poland amounts to 0.404. This total semi-elasticity stems from aggregation of elasticities of individual revenue (PIT, CIT, social security contributions, indirect taxes and non-tax revenue) and expenditure (unemployment-related) categories weighted by their share of GDP. This methodology has been applied by the EC since 2013 (see Mourre et al. 2013). Before that update, the EC used to compute sensitivities instead of semi-elasticities but the final outcomes for structural balances were not much different than current ones, so the update did not affect findings based on the analysis.

Chart 1
Empirical distribution of an output gap in EU Member States, in % of GDP



Source: Ameco database

A negative output gap must be lower than 2%/0.404 = 4.95% to ensure that cyclical deficit is bearable. Taking into account a sample of 28 EU countries over all possible years (1965-2015) in the Ameco database, in only 3.9% of cases output gaps exceeded -5% (see chart 1) which can be translated into aforementioned 'every 25 years'. It never happened to Poland, as well as 14 other EU countries, though. To easier grasp the magnitude of a negative output gap wider than 5%, one can indicate some recent examples of countries facing such a severe recession: Cyprus (-5.8% in 2013, -6.5% in 2014), Spain (-5.1% in 2012, -5.2% in 2013), Sweden (-5.7% in 2009) or Finland (-5.6% in 2009). The output gaps in Greece, Latvia and Lithuania after 2008 were even larger.

As the stabilising expenditure rule will target nominal balance in the medium term rather than structural balance every year, there should be no surprise if nominal deficit exceeds 3% of GDP more often than every 25 years. The question about the precise frequency was investigated in subchapter 3.5 of this paper.

3. Simulations of the Polish economy

The main goal of this paper is to demonstrate how Polish public finances may behave under the stabilising expenditure rule. In order to do so, deterministic and stochastic projections were carried out and analysed.

The categories that were simulated both in the deterministic projection and in the stochastic simulations were macroeconomic variables: real GDP growth, CPI inflation, GDP deflator; fiscal variables: general government (GG) expenditure, revenue and balance-to-GDP ratio (ordinary, structural and primary), discretionary revenue measures, public debt (calculated according to domestic and EU methodology); as well as the variables required by the SER: the sum of differences between GG balance and the MTO, and the correction component resulting from the automatic correction mechanism of the SER.

In the stochastic simulations, theoretical values were obtained from the models which were estimated on the basis of historical observations. Those theoretical values were supplemented by random components generated from logistic (and sporadically normal) distributions which were estimated on the basis of residuals from the aforementioned models. The logistic distribution was used because the Jarque-Bera test rejected the hypothesis about normality of the residuals, while the logistic distribution fitted well. In the deterministic projection, no random components were added.

All forecast figures until 2017 were obtained from the 2014 update of the Convergence Programme. The source of the real potential GDP growth and CPI inflation for the period from 2018 to 2040 was the guidance on the macroeconomic assumptions for the needs of the multi-annual financial forecasts of local government units (Ministry of Finance, 2013c). The alternative source of the long-term GDP and inflation projection for the deterministic projection was the EU Ageing Work Group (AWG) forecast (European Commission, 2012a), which is more pessimistic. In the AWG forecast average GDP growth in 2018-2040 is lower than the baseline by 1.2 pp.

No pension reform costs were assumed, because it was expected by the author of this paper, while performing the simulations at the beginning of July 2014, that only a minor group of people would remain in the Open Pension Funds.

Every time GG revenues or expenditures were mentioned in the context of the projection or the simulations, they should be interpreted as the consolidated categories calculated without items fully financed from EU funds, for deduction of the same amount from both sides of accounts is neutral from a deficit and debt perspective. Otherwise, predicting expenses financed by the UE in the long run would have been linked with huge uncertainty.

All equations described in subchapters 3.1-3.3, i.e. for the output gap, CPI, revenue/GDP and the debt interest rate, had some commonalities. First of all, the specifications were restricted to the key macroeconomic and fiscal variables. For instance, the possible decomposition of the GDP into consumption and investment has no impact on the public deficit, so it was irrelevant in this modelling framework. Also the possible influence of investment on economic growth was not modelled, because the potential GDP growth was assumed ex ante. The emphasis was put onto continuity between the recent forecasts for the Polish economy and the simulated values. As the simulations were run as far as until 2040, it was also very important to specify the models in a robust way, to grasp the substantial, basic and stable macroeconomic relationships at the cost of the complexity of the models.

3.1. Deterministic projection

The first projection was called deterministic, because all values of variables came from the long-term forecasts and did not include random terms. The outcomes of this analysis reflect only one path per each time series rather than distributions of variables presented in the next subchapter. Hence, the analytical framework was relatively simple which result in fewer conclusions which can be drawn based on this exercise. However, the results shown in this subchapter deserve attention, as one may interpret them as a baseline (central) scenario for Poland for the years 2014-2040.

In the deterministic projection, contrary to the stochastic simulations, the output gap was assumed after 2017 at the zero level. As a consequence, real GDP growth stemming from the forecast in the guidance on the macroeconomic assumptions was assumed to equal the potential one. Similarly, CPI inflation was assumed not to differ from GDP deflator. Both GDP and CPI forecasts were simulated with no errors. Hence, the adjustment for inflation forecast errors (see equation (3)) was redundant in this case.

According to the projection, after 2017 GG revenue increased in line with nominal GDP, so revenue-to-GDP ratio was perfectly constant (36.0%), no discretionary change in revenue in that period was assumed too. Some light should be shed on 2014 when state bonds managed by the Open Pension Funds (OFE) were transferred and matured in the Social Insurance Institution. As the result of that transfer, debt decreased by 9.3% of GDP but revenue and deficit which was relevant from the SER perspective were calculated without the effects of the transfer, so that the balance amounted to -3.5% instead of +5.8% of GDP.

In the years 2017-2040, GG expenditures were formed according to the SER. In 2013 forecast GG expenditures (as already mentioned – without categories fully financed by the EU) amounted to 0.6% more than the planned sum of expenditure covered by the SER (which was used as the starting *level of expenditure* in the SER). Therefore, since 2018 GG expenditures were assumed to be every year 0.6% higher than the *level of expenditure.* This difference accounted for the items neither covered by the SER, nor financed by the EU. The difference will be different if one sets actual GG expenditures against actual expenditures covered by the SER.

The GG deficit was obtained by deducting revenue from expenditure; while GG debt was defined as accumulation of deficits (cash-flow adjustments were ignored). This accumulation started from 2014, taking 2013 debt levels of both methodologies, presented in the Debt management strategy (Ministry of Finance, 2013b), as a starting point and adding to them respective deficits. The debt thresholds included in the correction mechanism referred to the public debt calculated according to the domestic methodology net of financial resources assigned for financing borrowing needs. In 2012 those resources amounted to 1.92% of GDP, so this fixed amount diminished public debt-to-GDP ratio compared to debt thresholds in the SER. Exchange rate fluctuations were not simulated. Two other debt thresholds stipulated in the Public Finance Act (55% and 60% of GDP) were not taken into consideration because the aim of this article was to assess the effectiveness of the stabilising expenditure rule alone, not the whole fiscal framework in Poland.

A primary balance plays an important role in the theory of fiscal policy as the variable which measures restrictiveness of the policy conducted by a government. In particular, it was used as the dependent variable in an equation for fiscal reaction function in subchapter 4.3. To compute the primary balance, debt interest payments should be deducted from the nominal balance. In order to model the debt interest rate, a panel OLS regression with fixed cross-section effects was run on time series over 1999-2013 for the euro area countries. A decision was made not to run a regression on the single Poland's time series, because the long-term MoF projection, used in this paper, assumed accession of Poland to the euro area. Therefore, all equations related to nominal categories in which currency issues matter (debt interest rate, inflation and GDP deflator), were based on the data for the euro area economies. On top of that, bond coupon rates in Poland became closer to the average rate in the euro area only quite recently, so the single Poland's time series would not be long enough for the robust estimation of the model. The interest rate in the general case was modelled by the equation presented in table 1.

Table 1: Estimation output for debt interest rate

	(7)
Explained variable	Debt interest rate
Period Included observations	1999-2013 148 (EA10)
Estimation method	Panel LS Cross-section fixed
Constant	3.967*** 0.144
GDP deflator	0.265*** 0.064
Adjusted R^2 Standard error of regression Q statistic (4 lags) p-value (Q) Levin, Lin & Chu Unit Root test p-value (LLC) Jarque-Bera test p-value (JB)	0.115 0.904 122.53 0.000*** -0.872 0.191 1.858 0.395

This model was designed only in order to calculate a level of debt interest payments which were necessary to obtain the primary balance (recall that the SER refers only to the nominal balance and the aggregate expenditures). Thus, the explained variable should not be identified with any other interest rates in the economy in particular with the reference interest rate, which has an impact on the whole economy, is determined by the Monetary Policy Council and could be modelled by a some kind of the Taylor rule.

One must admit that equation (7) is a very rough model. However, most of the factors affecting the bond markets, e.g. political issues or investors' psychology, are difficult to be modelled and the uncertainty about the future economy is great, thus the role of the random component must be huge in this case. For the sake of the deterministic projection, the random component was not taken into account – in contrast to the stochastic simulations (see subchapter 3.3).

All the equations described in this subchapter and referred only to years after 2017 were collected in table 2.

Table 2: Model underlying the deterministic projection

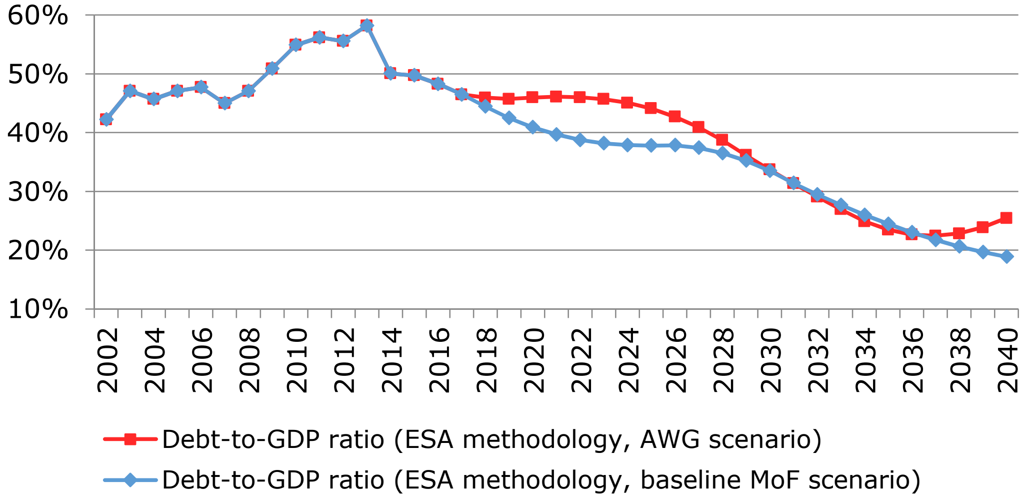
nominal GDP	= (potential GDP + gap) · GDP deflator
potential GDP	= exogenous
gap	= 0 (constant)
GDP deflator	= exogenous
CPI	= GDP deflator
revenue / GDP	= 0.36 (constant)
expenditure	= according to the stabilising expenditure rule
debt	= debt(-1) + expenditure – revenue
debt interest rate	= 3.967 + 0.265 · GDP deflator

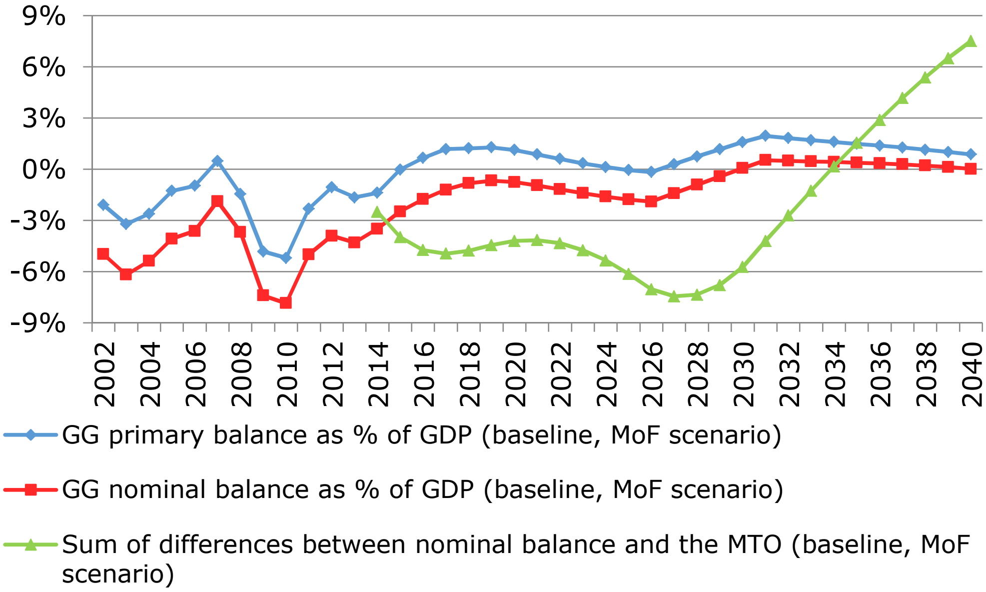
One general, important point which is valid for all results discussed in this paper should be emphasised before they are presented. The results are burdened by the uncertainty stemming from the models which serve as the data generating processes. Therefore, all outcomes should be interpreted with the appropriate caution.

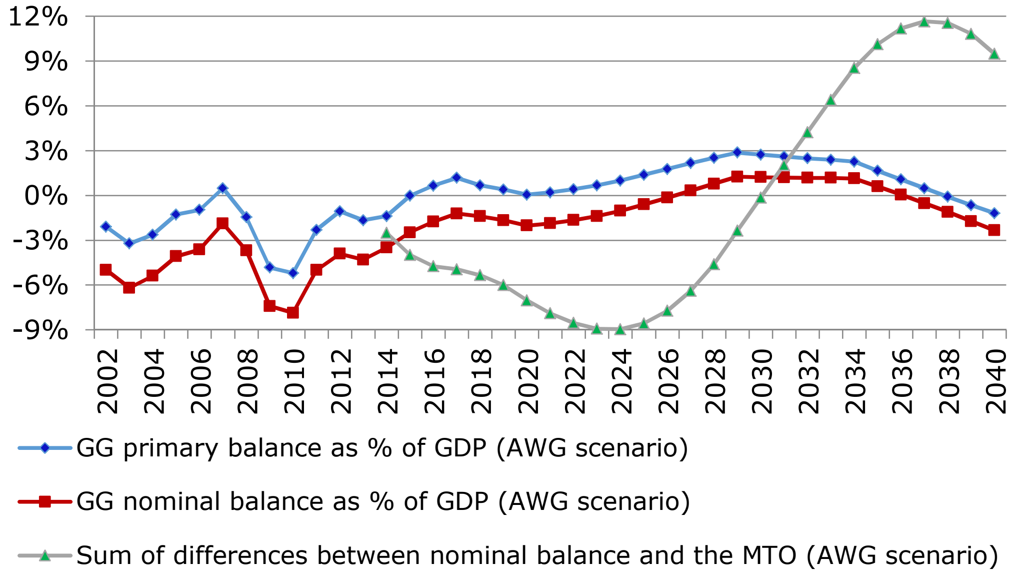
The results of the deterministic projection can be found in the charts 2-6. A good way to comment on them is to explain the general picture emerging from charts 2-3, showing the debt-to-GDP ratio and GG balances, by expenditure formation (chart 5) implied by the stabilising expenditure rule and its correction mechanism (chart 6). In general, ESA debt diminishes in relation to GDP from about 50% in 2014 slowly to 40% in 2020's and continues downward trend till the end of the considered period (chart 2). For the robustness check, the projection was also calculated based on the AWG forecast. This more pessimistic economic growth scenario made debt falling very slowly till 2027 but then it converged to the path generated in the baseline scenario.

As can be seen in chart 3, the gap between primary and nominal balance is closing due to the diminishing debt-to-GDP ratio. In 2018 nominal balance achieves the MTO (-1% of GDP) and remains more-or-less at this level, decreasing very slowly. This is because of the fact that medium-term real GDP growth indicator is mostly past-oriented, whereas real GDP dynamics smoothly deteriorates (the catching-up effect of the Polish economy, converging to the advanced ones, is getting exhausted). As a consequence, real expenditure rise a bit faster than GDP (chart 5), while it is assumed that revenue move at the same pace as GDP. Eventually, in 2027 the correction is applied and takes place until 2031 (charts 5-6), which redirects nominal balance toward null level (see again chart 3). At the end of the analysed period, in 2039 *sum* *of differences* exceeds +6% of GDP, so the positive correction is to be applied soon after 2040 which will redirect nominal balance again toward the MTO. Nevertheless, such changes by 1 p.p. in the balance are so small compared with the past volatility of this fiscal variable that can virtually be neglected.

Charts 2-6
Results of the deterministic projection



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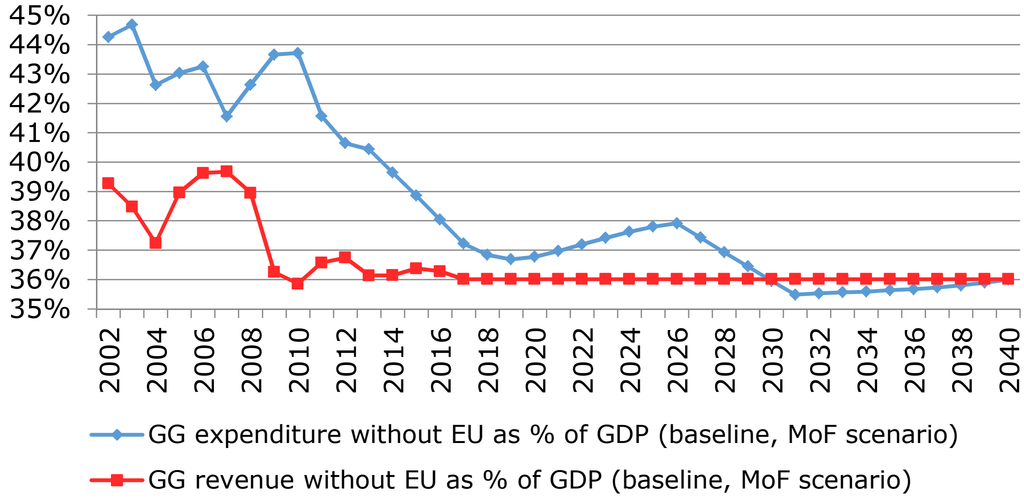
2040
GG primary balance as % of GDP (AWG scenario)
GG nominal balance as % of GDP (AWG scenario)
Sum of differences between nominal balance and the MTO (AWG scenario)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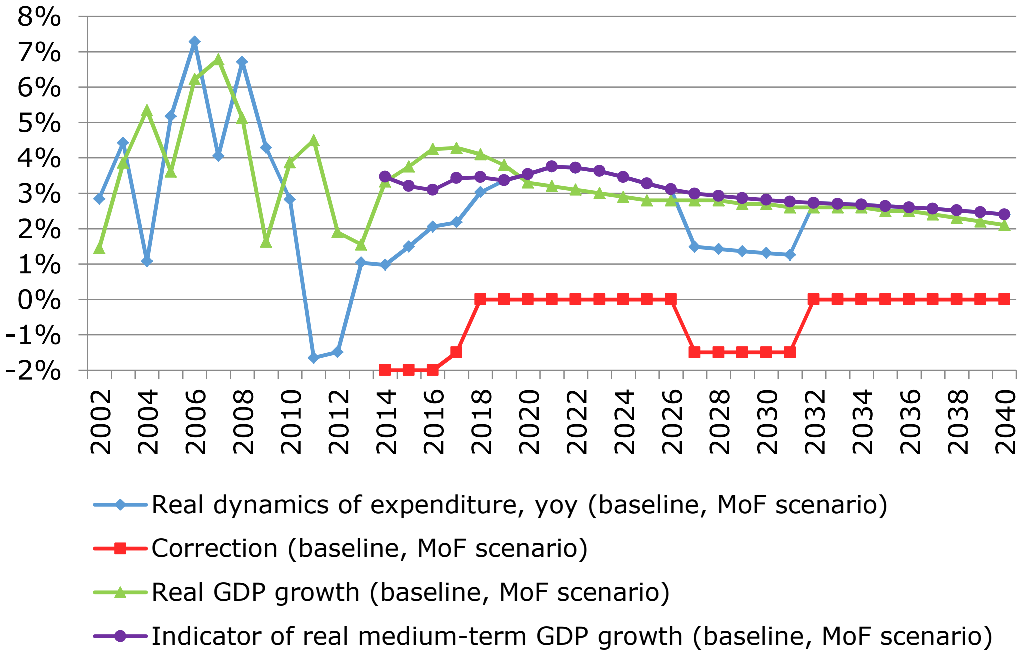
GG expenditure without EU as % of GDP (baseline, MoF scenario)
GG revenue without EU as % of GDP (baseline, MoF scenario)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Real dynamics of expenditure, yoy (baseline, MoF scenario)
Correction (baseline, MoF scenario)
Real GDP growth (baseline, MoF scenario)
Indicator of real medium-term GDP growth (baseline, MoF scenario)

The results of the alternative projection, carried out under the AWG forecast was presented partly in charts 2 (partly) and 4. It was different to a certain extent, because *the sum of differences* exceeded the negative threshold as soon as in 2019 (compared with baseline 2025). Under the AWG scenario, due to the adverse economic condition, the correction not only began earlier, but also lasted longer (9 years rather than 5 years). Thus the correction mechanism managed to reduce the debt-to-GDP ratio strongly. In 2035 even the positive correction was triggered due to the excessive positive *sum of differences*. All in all, as it was presented in chart 2, debt-to-GDP ratios under both scenarios were similar, especially since 2029.

There are three main conclusions stemming from this analysis. 1) The critical point in relatively near future is the year 2016. According to the projection, public debt net of financial resources allocated to fund borrowing needs, will amount in 2016 to 42.8% of GDP, i.e. on the verge of the threshold.

2) The correction mechanism works efficiently and smoothly but 3) without active revenue policy, the rule is too restrictive in the long run. The restrictiveness is dictated by the fact that the correction mechanism 'is equipped with memory'. Thus, in the SER it is not enough for a nominal balance to come back after a significant deviation to the MTO level (as it is stated in the principles on the correction mechanism (European Commission, 2012b)) but it has always to restore the mean nominal balance to this point, which is more rigorous. Admittedly, in the long run debt-to-GDP ratio below 30% can be perhaps assessed as too ambitious. In such case, the MTO might be slightly relaxed, so that the downward trend apparent in graph 2 might be weaken or even stopped. Also the lower than assumed economic growth rates would make debt-to-GDP decreasing slower. In addition to that, active revenue policy might affect the deficit and debt in spite of the SER, because in the discretionary measure component only changes in taxes and social contribution that exceed 0.03% of GDP are taken into consideration. Also the active expenditure policy would be possible but only the restrictive one, since the SER determines maximum *level of expenditure* and does not determine the minimum.

3.2. Modelling an output gap and CPI in the stochastic simulations

Introduction of random components into equations for the output gap, CPI, the interest rate and revenue; addition of forecast errors and deviations of the GDP deflator from CPI constitute important developments in the stochastic simulations in comparison with the deterministic projection. All the equations which establish the model underlying the simulations for the years 2018-2040 were collected in table 3 below. The equations were estimated over the period 2000-2013 but two of them concerning the real sphere of economy (the output gap, revenue/GDP) – on the EU 27, while two other, concerning the nominal sphere of economy (CPI, the debt interest rate) – over the EA 13. The reasons behind this division were given partly in subchapter 3.1 and will be supplemented further in this subchapter. As a final point, it is worth adding that the standard errors were always estimated by the robust White-period method.

Table 3: Econometric model underlying the stochastic simulations

nominal GDP	= (potential GDP + gap) · GDP deflator
potential GDP	= exogenous
gap	=-0.255 + 0.854 · gap(-1) – 0.398 · gap(-2)
	+ 0.108 · expendit. dyn. + ε
Δ CPI	= -0.704 · [CPI(-1) – 0.02] + 0.225 · gap + ε
GDP deflator	= CPI + ε
Δ (revenue / GDP)	= -0.373 · [(revenue / GDP)(-1) – 0.36] – 0.04 · gap + ε
expenditure	= according to the stabilising expenditure rule
debt	= debt(-1) + expenditure – revenue

Probably the most crucial drawback of the deterministic projection was the lack of business cycles. In other words, the output gap was always closed. In contrast, in the stochastic simulation an AR(2) process, based on historic data for 27 EU countries over the period 2000-2013, from the Ameco database, was introduced in order to model the output gap (see equation (8)). Hence, the sample consisted of as many as nearly 400 observations – the wide spectrum of various business cycles in different EU member states. Such a sample, including not only the euro area counties like in the regressions for CPI and debt interest rate, reflects the uncertainty concerning projections of output gaps for many years ahead. It was assumed that amplitude and shape of business cycles which will occur in Poland will not be specific and may resemble past cycles in any EU country.

A constant in equation (8) was excluded for theoretical reason – typically business cycles are symmetric, at least those extracted by statistic methods. Yet significant negative constant terms appeared in regression (9)-(11), because they compensate there for the expenditure dynamics which on average is not zero (contrary to the output gaps). To obtain real GDP, the output gap was added to the potential GDP which was assumed at the level implied by the long-term projection (Ministry of Finance, 2013c). However, in line with the economic theory saying that an impact of fiscal policy on economic growth should not be ignored, T-student test rejected the hypothesis that the output gap does not depend on the real general government expenditure dynamics. In opposition to that, the constant (exogenous) path of potential GDP seems reasonable. One should take into account that the nominal balance, according to the SER, amounted to the MTO level. This means that public demand was also to be constant on average, so it had the same impact on potential GDP in all scenarios.

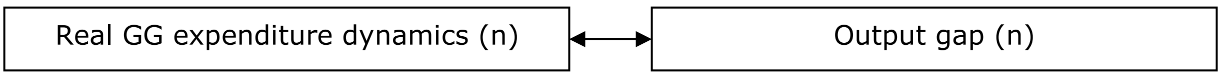
Table 4: Equations for an output gap

	(8)	(9)	(10)	(11)
Explained variable	Output gap	Output gap	Output gap	Output gap
Period	2000-2013	2000-2013	2000-2013	1970-2013
Included observations	378 (EU27)	378 (EU27)	332 (EU276)	674 (EU27)
Estimation method	Pooled LS	Pooled LS	Pooled LS	Pooled LS
Output gap (-1)	0.922*** 0.056	0.854*** 0.066	0.842*** 0.076	0.880*** 0.049
Output gap (-2)	-0.405*** 0.047	-0.398*** 0.044	-0.397*** 0.045	-0.365*** 0.037
Constant		-0.255** 0.127	-0.490*** 0.169	-0.176** 0.071
Real GG expenditure dynamics		0.108** 0.049	0.126** 0.058	0.064** 0.027
Real GG expenditure dynamics volatility over 8 years			5.221** 2.470	
Adjusted R^2	0.512	0.533	0.534	0.534
Standard error of regression	0.023	0.022	0.023	0.019
Q statistic (4 lags)	6.389	8.319	10.492	8.266
p-value (Q)	0.172	0.081*	0.033**	0.082*
Levin, Lin & Chu Unit Root test	-4.980	-5.317	-4.413	-10.298
p-value (LLC)	0.000	0.000	0.000	0.000
Jarque-Bera test	472.650	326.903	256.540	1107.440
p-value (JB)	0.000	0.000	0.000	0.000

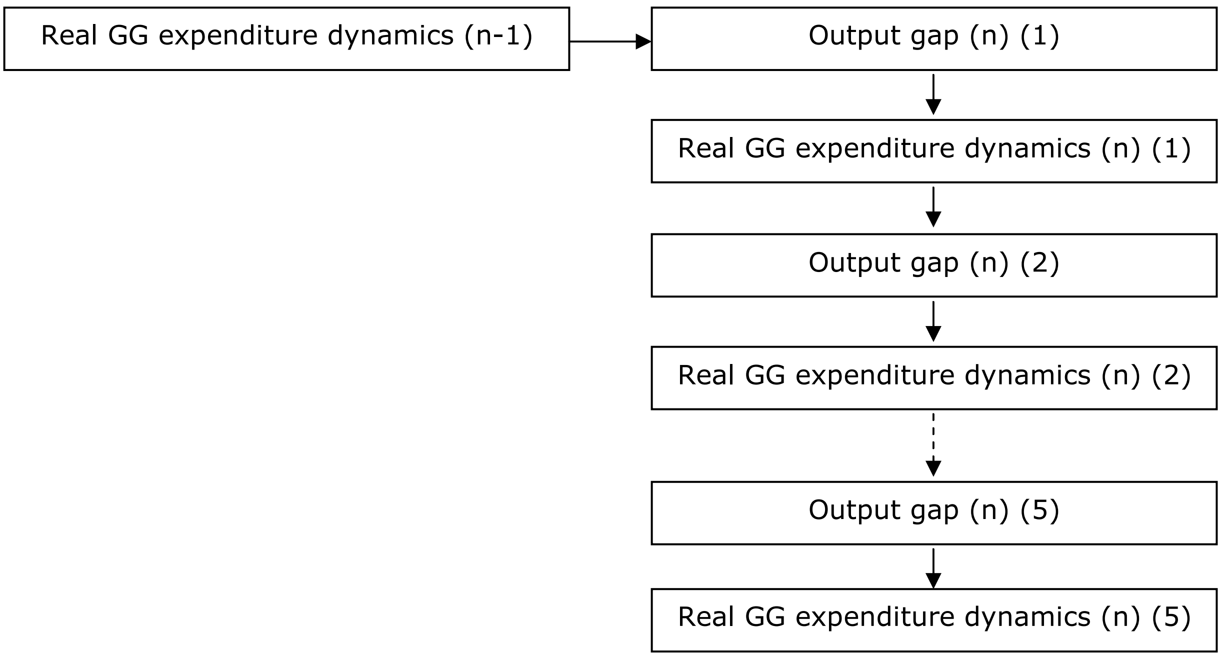
However, introducing the fiscal variable (compare equations (8) and (9)) resulted in emergence of a loop reference, namely: an expenditure dynamics affects an output gap which in turn affects GDP growth which is included in the indicator of real GDP medium-term growth which is in turn used in computation of an expenditure dynamics. To avoid such a cyclical reference (see also scheme 1), a 5-step algorithm was designed and run since 2017. Only the relationship between the expenditure dynamics and an output gap has been so far described, though the algorithm was applied also in case of some other variables. Another example was mentioned in subchapter 3.3.

The algorithm works as follows. In a first step, the equation for an output gap uses last year expenditure dynamics which is a fixed outcome and cannot be changed. It approximates current value very roughly, though it serves as a starting value, which allows for triggering the whole procedure. Then, all other macro and fiscal variables based directly and indirectly on the output gap are calculated. One of them is the real GG expenditure dynamics. In a second step, the expenditure dynamics obtained in a previous step enters into the equation for the output gap. Other variables are calculated respectively. Afterwards, third and fourth step are taken. In a similar way, the expenditure dynamics obtained in a fourth step enters into the equation explaining the output gap for the last – fifth time. The results of the simulation indicate that all variables calculated according to this five-step algorithm converge for every year very fast to their 'steady states'. That was shown at the end of subchapter 3.3. The observed convergence allowed for eliminating the aforementioned technical loop reference but at the same time enabled keeping the interdependence between the expenditure dynamics and an output gap. This is because the expenditure dynamics obtained using an output gap calculated during a fifth step is virtually the same as the expenditure dynamics used in a fifth step in the equation for an output gap (see also scheme 2). Finally, it is worth mentioning that algorithms which are commonly used in econometrics to solve equations, invented by Gauss-Siedel and Newton, were not used here because either they refer to only linear equations (which is not the case as regards e.g. the SER), or they require computing derivatives (which would be cumbersome in the case hereby described).

Scheme 1: Assumed relationship in the stochastic simulation



Scheme 2: Technical solution to avoid a loop reference shown in scheme 1 in computations



Having discussed the problem of the mutual relationship between the output gap and the expenditure dynamics from the simulation perspective, we now comment on it from the econometric perspective. In general, multiequation models (such as that formulated in table 3) should be estimated by the 2- or 3-stage least squares (2SLS or 3SLS) method in order to avoid the simultaneity bias problem. This problem consists in the inconsistency of the estimator if in one equation variable A is explained by B, while in other equation it goes another way round – variable B is explained by A. Table 3 consists of four equations which are estimated. However, three of them are not suspected at all: revenue/GDP is not explained by any other macro-fiscal categories; debt interest rate is explained by GDP deflator but not vice versa, as well as CPI which is explained by the output gap but not vice versa.

The only dubious equation (9) is the one for the output gap because it depends on the expenditure dynamics, while simultaneously the expenditure dynamics depends on the output gap. In this case, the econometric theory recommends to replace empirical values of the expenditure dynamics by theoretical values of this variable obtained from the additional equation consisting of only exogenous variables. Unfortunately, such an auxiliary equation, i.e. expenditure dynamics explained by two lags of the output gap and GDP deflator is so poorly fitted, that unadjusted R-square amounts to as little as 0.15. In other words, the instruments are weak, so the theoretical values of the explained variable are characterised by the large standard error. To summarise, the 2SLS estimation would bring no added value for the discussed model.

Equation (9) was finally used in the simulations. Another variable was being considered to be added, namely a real GG expenditure dynamics volatility over last 8 years (see equation (13)). While looking for anything which might make the model prone to the Lucas critique (Lucas, 1976), one should compare characteristics of fiscal policy conducted before and after introducing the stabilising expenditure rule. First, obvious difference consists in a different, more stringent fiscal target, the MTO. Admittedly, it would be binding regardless of the SER, but the rule forces the automatic correction in the event of the excessive deviation from it. The link between fiscal policy and economy is already present in equation (9).

Second, less evident difference, consists in probably lower volatility of real GG expenditure dynamics. Thanks to the SER, expenditures are going to be determined quite steadily, in counter- or acyclical way (depending on whether they are expressed as % of GDP or as real growth rate), which might weaken business cycle fluctuations. Perhaps this will indeed happen in the Polish economy but equation (10) does not confirm such a hypothesis. A conclusion can be drawn that the real GG expenditure dynamics volatility, expressed as the standard deviation over last 8 years, has no explaining power of an output gap. As there was no added value in incorporating this variable into the model (neither significant improvement in adjusted-R^2, nor in Q-statistic, high standard error and counterintuitive sign of the parameter estimate), equation (9) was chosen. A similar situation took place while specifying a model for CPI. For the purpose of the robustness check, equation (11) was estimated on the larger sample covering years starting from 1970. The parameter estimates were consistent with those obtained in regression (9).

A hypothesis that residuals follow a normal distribution was rejected by Jarque-Bera test. Fortunately, from the econometric point of view, normality of residuals is not necessary if a sample is large. However, every time the output gap was simulated, a random component was drawn from the logistic distribution which fitted to the empirical distribution of residuals of equation (9). This random component was added to the deterministic part of the equation. A zero restriction was imposed on the location parameter of the logistic distribution for two reasons. Firstly, the estimated value of this parameter did not differ from zero significantly which is not a surprise as a mean residual obtained from OLS must equal zero. Secondly, the restriction is consistent with the expectation that an unobservable disturbance term should be on average equal to zero. An estimate of the scale parameter amounted to 0.991 and was significant under every reasonable significance level. Moreover, a hypothesis that the residuals come from the logistic distribution, was rejected neither by Cramer-von-Mises and Anderson-Darling tests (p-values between 0.1 and 0.25), nor by Watson test (p-value between 0.025 and 0.05). In a similar vein, random components were generated in the equations for CPI, the GDP deflator and revenue.

We now turn to another variable: change in the CPI inflation. This time the sample was restricted to the first wave of the euro area member states – ten countries – all but Luxembourg (because of its specific characteristics). The reason was that the long-term forecast, used in the deterministic projection and, as regards the potential GDP, also in the stochastic simulations, was prepared by the Ministry of Finance (2013c) under the assumption that Poland would enter the euro area. Therefore, Poland's inflation and interest rates will converge to those which are present in the euro area. An evolutionary process of modelling GDP deflator was synthesized in table 5.

Table 5: Equations for CPI

	(12)	(13)	(14)	(15)
Explained variable	Δ CPI	Δ CPI	Δ CPI	Δ CPI
Period Included observations	2000-2013 138 (EA10)	2000-2013 138 (EA10)	2000-2013 137 (EA10)	2000-2013 134 (EA10)
Estimation method	Panel LS	Panel LS	Panel LS	Panel LS
Constant	1.660*** 0.322			
CPI (-1)	-0.737*** 0.178			
CPI (-1) – 2%		0.619 0.388	-0.704*** 0.072	-0.730*** 0.153
Output gap			0.225*** 0.080	0.224*** 0.077
GG expenditure real dynamics volatility over 8 years				3.670 3.634
Adjusted R^2	0.372	-3.662	0.520	0.528
Standard error of regression	1.079	2.408	0.943	0.946
Q statistic (4 lags)	8.367	15.284	3.295	3.327
p-value (Q)	0.079	0.004	0.510	0.505
Levin, Lin & Chu Unit Root test	-8.436	-9.827	-4.162	-3.823
p-value (LLC)	0.000	0.000	0.000	0.001
Jarque-Bera test	8.670	28.304	1.123	0.557
p-value (JB)	0.013	0.000	0.570	0.757

First of all, equation (12) was specified (after a transformation) as AR(1) process with a constant and then estimated. However, it rather poorly fitted data. Moreover it did not take into account that the ECB target was the inflation slightly below 2%. Hence, equation (13) was specified in such a way that the linear combination of two regressors from equation (12), $\alpha_0 + \alpha_1 x$, was replaced by an error correction term, $\beta(x\text{-}2\%)$. Such a transformation was justified not only from a theoretical perspective but also from a statistical one, as Wald test, applied to equation (12), did not reject the null hypothesis on a coefficient restriction: $\alpha_0=-2\alpha_1$ (p-value = 0.56).

An addition of the output gap (see equation (14)), thanks to which a form of the Phillips curve emerged, improve the fitness and results of both the autocorrelation test and the normality test. In the end, equation (14) was used in the simulations. Equation (15) was rejected, because the variable measuring volatility of expenditure turned out to be insignificant. A random component was generated from the logistic distribution, in a similar way as in the model for the output gap. The only difference is that scale parameter came to 0.521.

3.3. Other assumptions behind the stochastic simulations

In the former subchapter the method of modelling CPI inflation was outlined. Although the GDP deflator moves in line with CPI inflation in the long run, it is obviously a different measure. It takes into account imported goods instead of exported ones and in the short run growth rates of import and export prices can be different. On average, CPI differed in absolute terms from the GDP deflator dynamics by about 0.8 pp over the period 1999-2013 in the ten euro area countries. The logistic distribution with the location parameter restricted to 0 and the scale parameter being equal to 0.547 was fitted to the empirical distribution of those differences between CPI and GDP deflator. All three tests mentioned in subchapter 3.2 did not reject the null hypothesis about 'logisticity' of the distribution. This distribution was then used in the simulations to model CPI after 2017.

All values of variables until 2017 were taken from the 2014 update of the Convergence Programme. The only exceptions were forecasts of real GDP growth and the CPI inflation, which needs a further comment. The formula of the stabilising expenditure rule comprises four GDP and CPI forecasts. The CPI forecasts occur in equation (1) and (2). As regards equation (2), only the nominators should be considered because the denominators include old forecasts which are already known in year n. Mean absolute errors (MAE) in CPI forecasts depend on time of performing a forecast. If a forecast of CPI in year n is made for the sake of a budgetary act for year n+1, so in year n, MAE amounts as little as 0.3 pp (see column $E_{n+1}CPI_n$). The error is so small because a few monthly outcomes are already known while making a forecast. If a CPI forecast is prepared for the same year as a budgetary act, then there are no monthly outcomes yet, so MAE amounts to 1.7 pp (see column E_nCPI_n). It works in a similar way with real GDP growth forecasts which are also used twofold, in the real medium-term GDP growth indicator (see equation (4)).

The forecast errors were simulated stochastically as follows. Firstly, a random component was drawn from one of four logistic distributions fitted to the sample of the aforementioned absolute forecast errors supplemented by their counterparts with negative signs. In all logistic distributions zero restrictions were imposed on the location parameters. The scale parameters were estimated. Secondly, this random component was added to a real outcome of a respective variable. Therefore, the forecasts were unbiased. Due to the problem of a cyclical reference, the algorithm explained in scheme 2 in subchapter 3.2 was applied.

The forecasts of GDP and CPI in 2014-2017 unveiled in the 2014 update of the Convergence Programme were treated as the true macroeconomic-fiscal scenario, while forecast errors were simulated stochastically. Otherwise, if no errors had been assumed, the SER would have worked too smoothly. Only two figures: the CPI and GDP forecasts for 2014 performed in 2013 were assumed at the fixed levels because they were obtained exceptionally from the Public Finance Act (Act revising(…), 2013).

As it has been stated, most of the variables have been stochastically simulated since 2018. GG expenditure was formed according to the SER in a way described in subchapter 3.1 on the deterministic projection. GG revenue-to-GDP ratio fluctuated in line with equation (17) which consisted of the error correction term (note that: $\alpha + \beta \cdot revenue(-1)$ can be easily transformed into: $\beta \cdot [revenue(-1) - \gamma]$, where $\gamma = -\alpha/\beta$), as well as the output gap which was the significant variable improving slightly goodness of fit of the model compared with equation (16). Regression 17 was estimated for the sample consisting of 27 EU countries over 2000-2013 by the panel least squares method with cross-section fixed effects. In the case of Poland this effect amounted to -0.0158, so it might be shown that in the long run, in the simulations, revenue-to-GDP would have to oscillate, thanks to the error correction term, around 37.9%, which is just the historical mean of this variable in Poland in 2000-2013 (37.9%). However, finally a constant, 0.157, in equation (17) was replaced by a little bit lower value, 0.134, in order to obtain revenue-to-GDP oscillating around 36.0% which is consistent with the figures assumed in the deterministic projection after 2017. Recall that the last forecast revenue-to-GDP figure in the Convergence Programme (Ministry of Finance, 2014) is 36.0% in 2017. A random component in the equation for revenue was drawn from the logistic distribution with the location parameter restricted to zero and the scale parameter estimated at 0.71%.

Table 6: Estimation output for revenue-to-GDP ratio

	(16)	(17)
Explained variable	Δ Revenue/GDP	Δ Revenue/GDP
Period Included observations	2000-2013 378 (EU27)	2000-2013 378 (EU27)
Estimation method	Panel LS Cross-section fixed	Panel LS Cross-section fixed
Constant	0.154*** 0.027	0.157*** 0.028
Revenue/GDP(-1)	-0.364*** 0.065	-0.373*** 0.066
Output gap		-0.042* 0.024

Adjusted R^2	0.173	0.181
Standard error of regression	0.012	0.012
Q statistic (4 lags)	1.219	1.499
p-value (Q)	0.875	0.827
Levin, Lin & Chu Unit Root test	-3.519	-3.724
p-value (LLC)	0.000	0.000
Jarque-Bera test	1254.989	1157.041
p-value (JB)	0.000	0.000

All other time series related to public finance: the GG balance, GG and state public debt ratios and forecast discretionary revenue measures were determined in the same manner as in the deterministic projection. Only the equation for the interest rate (7) was enhanced by the addition of the random term generated from the logistic distribution with the location parameter traditionally restricted to zero and the scale parameter estimated at 0.483. It is also worth mentioning that the structural balance could be calculated according to formula (6) in the stochastic simulations thanks to the output gap series. No one-offs were envisaged.

The last issue which needs some explanation in this subchapter concerns convergence of the variables which were calculated in the 5-step algorithm. The convergence was achieved. Otherwise the simulations would have deserved for hard critique from the methodological point of view. The convergence was examined as a difference between a value at a given step and a final value. If a variable was expressed in levels, the difference was expressed in relative percentage terms, while in other cases the difference was expressed in absolute terms. Naturally, the further step, the smaller difference could be observed. For instance, maximum annual difference in a single scenario for the *level of expenditure* implied by the SER between 1st and 5th step usually amounted to about 7%, whereas between 4th and 5th step – only about 0.05% which can be ignored. However, in some scenarios there were deviations from this rule. The extreme cases can be found in table 7 but still these are not dramatic values, taking into account that they happened once per 27000 observations.

Table 7: Maximum relative / absolute differences between values of variables in nth and final, 5th step observed in 1000 simulations over period 2014-2040

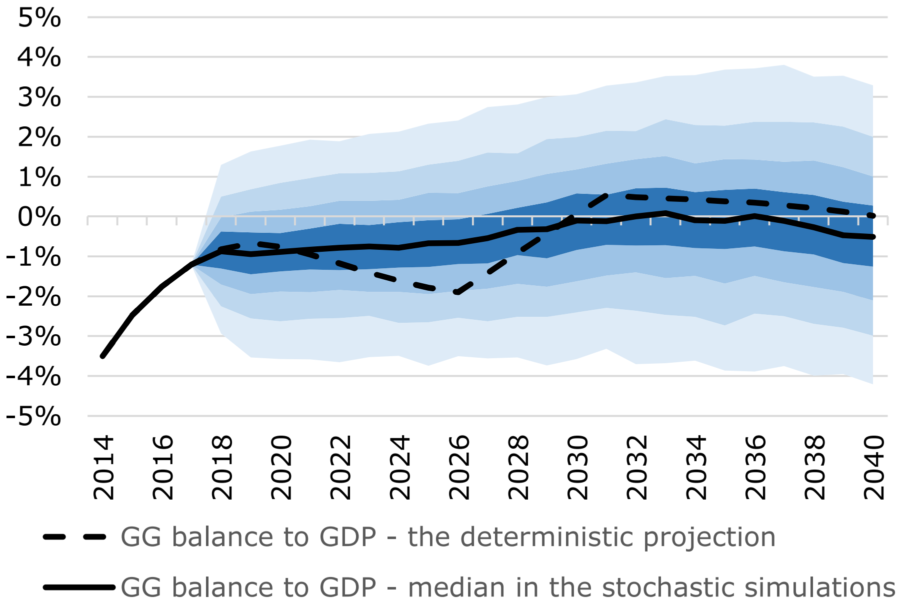
	Level of expenditure	Nominal GDP level	Output gap	Nominal GDP growth	GDP deflator dynamics	CPI inflation
Difference	relative	relative	absolute	absolute	absolute	absolute
1st – 5th	5.0%	32.4%	3.0%	8.0%	3.1%	3.1%
2nd – 5th	3.7%	1.1%	0.8%	1.7%	0.2%	0.2%
3rd – 5th	1.5%	0.6%	0.5%	1.1%	0.1%	0.1%
4th – 5th	1.5%	0.2%	0.2%	0.4%	0.0%	0.0%

3.4. Results of the stochastic simulations

To investigate the behaviour of the Polish economy and the public finances in terms of distributions of the most essential variables, one thousand Monte Carlo simulations were carried out. Each simulation stands for a single scenario which was created based on 9 different random components in: the output gap, CPI, the deflator, the interest rate, revenue, which were modelled stochastically since 2018, as well as GDP and CPI forecasts – modelled stochastically since 2014-2015 (details in subchapter 3.3). All fan charts (6-8) consist of black continuous lines which stand for the median values from the stochastic simulations, dashed lines – for the deterministic projection and colour-shaded areas representing all deciles from 1st to 9th. Not surprisingly, the ranges are becoming ever wider over time due to increasing role of randomness.

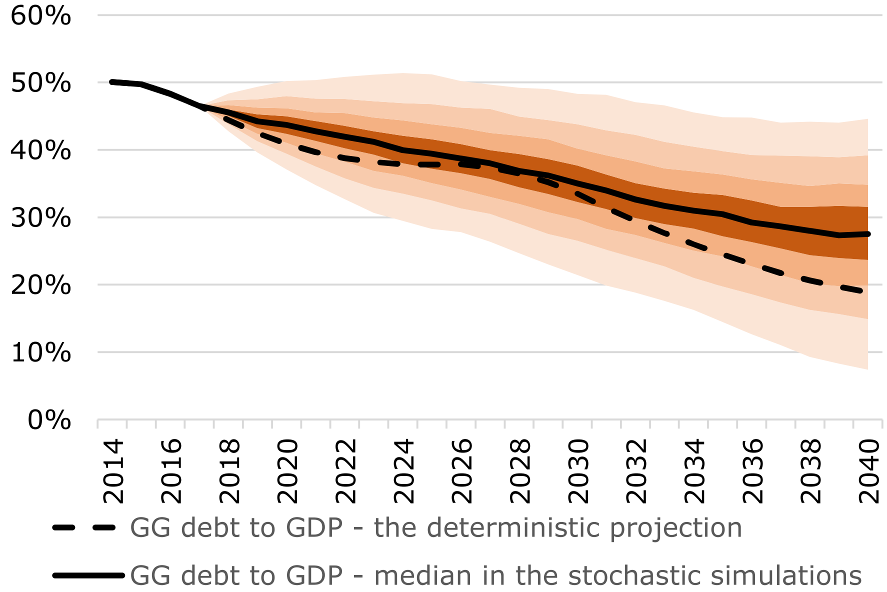
The median line in chart 6 describing formation of the nominal balance is quite similar to the respective line coming from the deterministic projection (also shown in chart 3). There are only two years, 2025-2026, when the gap between both lines exceeds 1% of GDP. In line with an expectation, the median nominal balance oscillates close to the MTO. However, according to the simulations the nominal deficit breaches the 3%-threshold on average once every six-seven years in 2018-2040, which is caused by the anticyclical feature of the rule. Even though following the SER is not enough to ensure that the nominal deficit is kept below 3% of GDP, the improvement is obvious, as the average nominal deficit in Poland, in period 2001-2013 amounted to as much as 4.9% of GDP. But in order to change the fiscal policy stance so strongly, some additional effort will be required.

Chart 7
GG balance to GDP: median and deciles in the stochastic simulations and the deterministic projection



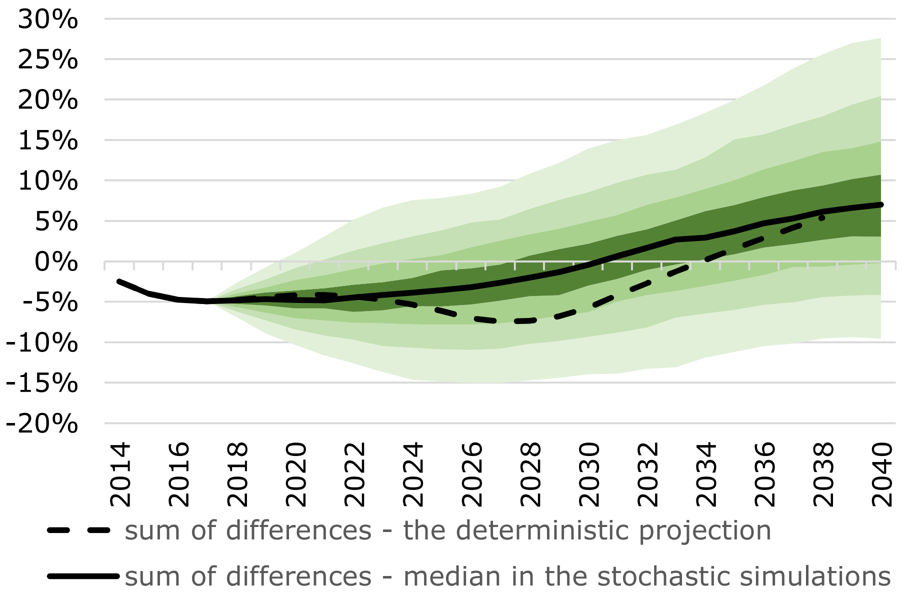
The central path of the stochastic simulations referring to the public debt and presented in chart 7 reminds of the equivalent from the deterministic projection. Both time series decline smoothly from 50% down to 20-30% of GDP. Under the assumptions described in previous chapters, the whole debt will be even fully paid off by the end of the analysed period with 3% probability. This would certainly induce tax policy reforms, some of which would not be classified as the discretionary revenue measures, so would have impact on deficit. As the main goal of the rule is to preserve the expenditure policy consistent with the MTO path the space for such a policy is limited. For the remark on restrictiveness of the SER please look back at the end of subchapter 3.1.

Chart 8
GG debt to GDP: median and deciles in the stochastic simulations and the deterministic projection



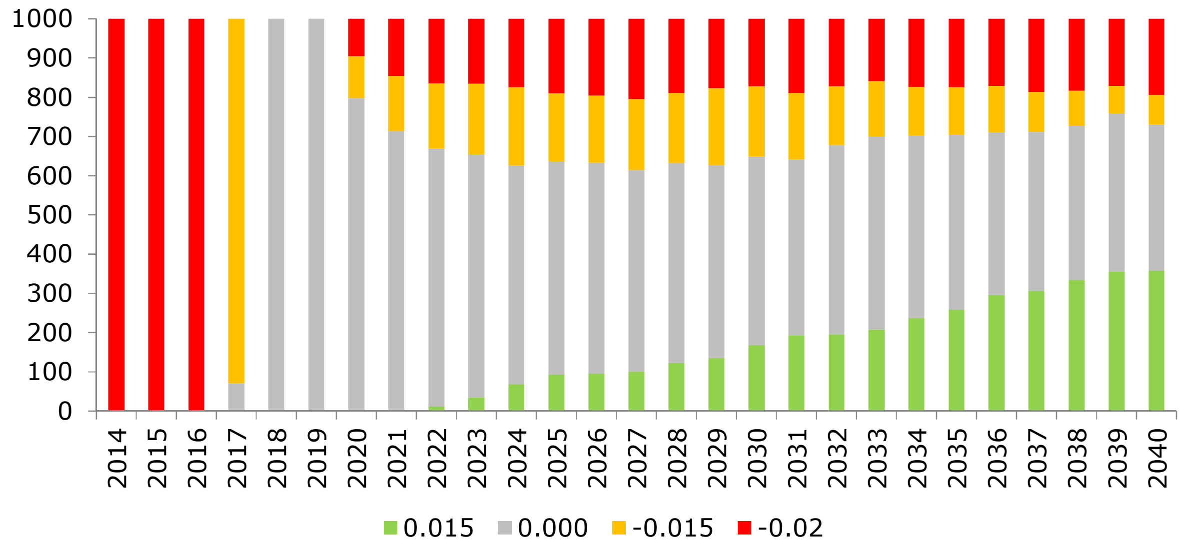
Ideally, *the sum of differences* between nominal balance and the MTO should fluctuate within the range ±6% of GDP over the cycle, so that there is no correction applied due to cyclical reasons. However, chart 8 demonstrates that *the sum of differences* may increase in absolute terms over time and even exceed the thresholds by a few lengths. Nevertheless, after the extreme year 2026, this variable returns successively towards zero, which shows how the correction mechanism works.

Chart 9
Sum of differences in the correction mechanism: median and deciles in the stochastic simulations and the deterministic projection



No rule can at the same time reduce and then stabilise debt ratio at a given level, stabilise structural deficit at the MTO and smoothen real expenditure dynamics. It could be seen in charts 6-8, that debt was indeed gradually reduced, while the median deficit amounted to nearly -1% of GDP. Yet the distribution of deficit was quite flat (it was not concentrated at the MTO) and the *sum of differences* went away from the ±6% of GDP range. Chart 9 confirms that even in the long run, the correction, either negative or positive, will be applied quite often. This might be problematic at least for two reasons: volatile expenditure dynamics makes long-term planning more difficult and it puts the government at a disadvantage if it has to begin term of office with the correction inherited after its predecessors. There are five factors which could lead to the less frequent correction: 1) stabilization of revenue-to-GDP ratio, e.g. indirectly thanks to the SER, already mentioned, 2) active revenue policy which would also affect some categories outside the discretionary revenue measures of the SER; 3) active restrictive expenditure policy; 4) relaxation of the MTO if it is technically possible and economically reasonable and 5) a margin under the limit set bigger or smaller depending on the current *sum of differences*. Having said that, one should not exaggerate the issue of the frequent correction, because a year-over-year change in expenditure dynamics by 1.5 – 2 pp, from the historical perspective of the Polish public finances, is nothing exceptional.

Chart 10
Distribution of the correction implied by the SER in 1000 simulations



4. Assessment of fiscal policy conducted according to the SER

4.1. Effect of lowering the debt thresholds

The decrease of the debt thresholds was examined by performing an alternative deterministic projection with higher thresholds and with the different *level of expenditure* since 2017 (in 2015-2016 correction amounted to -0.02 regardless of the debt thresholds). In 2017 the correction mechanism stopped indicating an excessive deficit (take note of the two-year lag in reporting the fiscal variables due to the fact that the correction mechanism is based on real data instead of forecasts), so the debt thresholds started to make a difference. It can be seen in table 8 that the divergence began indeed in 2017, for there was no correction in that year in the projection with higher thresholds. Revenue was assumed to be the same in both projections, so higher expenditure in the alternative projection resulted in higher deficit by 0.4-0.6 pp in 2017-2021. This, in turn, advanced the correction, lasting 5 years in both cases, due to the excessive *sum of differences.* Similarly, the positive correction also came earlier than in the base projection.

Table 8: Corrections in the deterministic projections under different assumptions on the debt thresholds in years 2014-2042: baseline (43 and 48%) and alternative (50 and 55%)

	14-16	17	18-21	22-26	27-31	32-38	39-40	(41-42)
43 and 48%	-0.02	-0.015	-	-	-0.015	-	-	+0.015
50 and 55%	-0.02	-	-	-0.015	-	-	+0.015	+0.015

The projections indicate that at the end of the period analysed in this paper debt-to-GDP would amount to 18.9% of GDP under the higher thresholds or 21.2% under the lower ones. In both cases the average nominal balance amounted to -0.7% of GDP. All in all, had the debt thresholds been higher, there would not have been much of distinction between the projections. This shows the effectiveness of the correction mechanism in the long run.

Yet the analysis of the both projections brings a following rationale for the lower debt thresholds than originally enshrined in the law. The SER has been introduced before the MTO is achieved. Therefore the correction in 2017 was necessary to tighten deficit, so that it can reach the MTO already in 2018. Otherwise, the MTO would be achieved only in 2022, definitely too late from the point of view of the EU Stability and Growth Pact (European Commission, 2013).

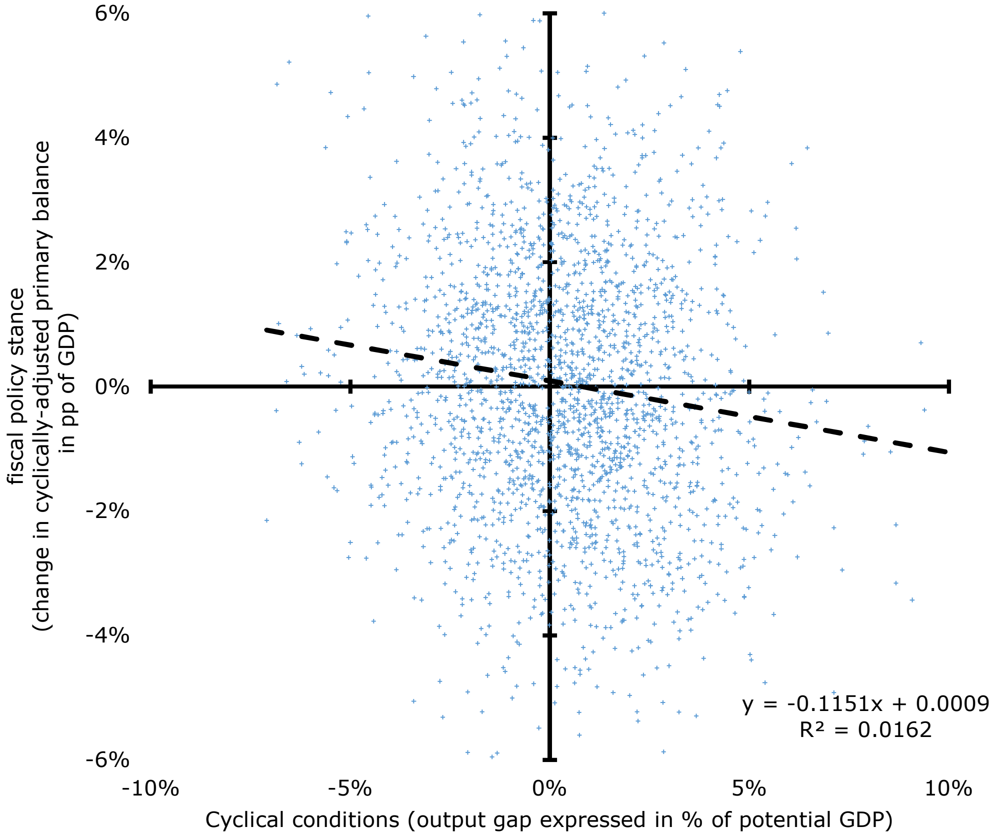
4.2. Cyclicality and sustainability of the public finances before and after the SER

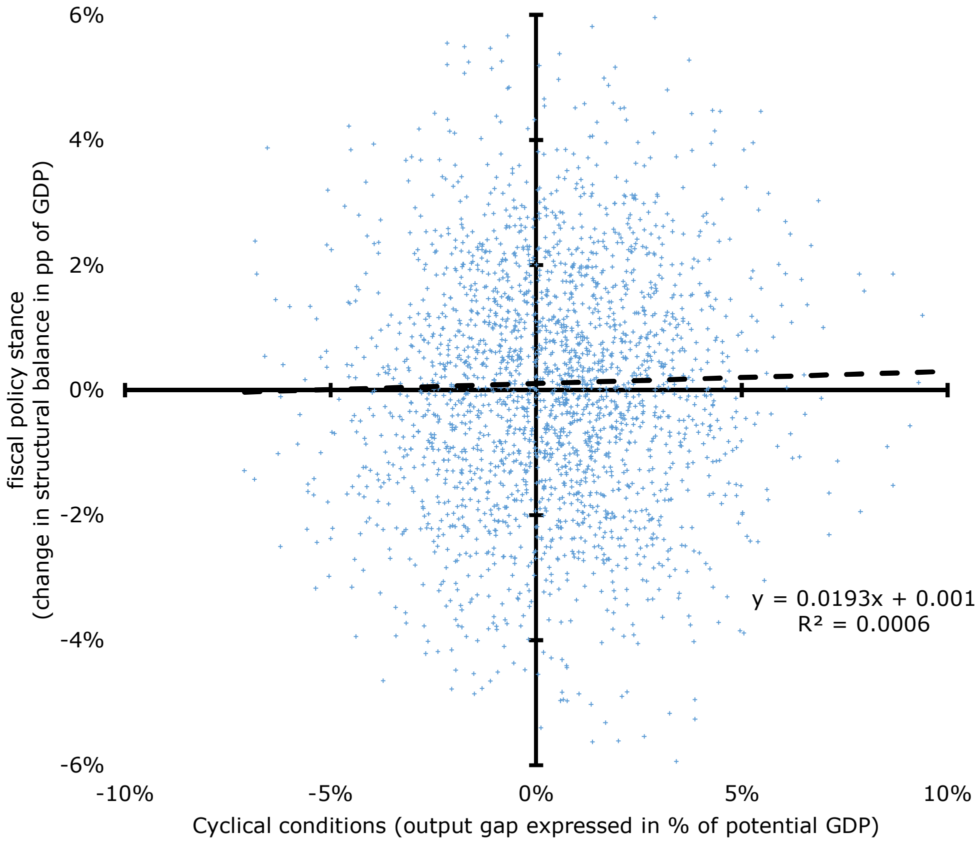
Fiscal policy is usually assessed under two criteria: countercyclical reaction to economic situation and long-term sustainability. Before the both criteria are analysed by more advanced methods, the first criterion can be simply assessed by the graphic method used by Jędrzejowicz, Kitala and Wronka (2009). Charts 10 and 11 present cyclicality of the fiscal policy forecast for 2014-2017 in the Convergence Programme (Ministry of Finance, 2014) and simulated for 2018-2040. Two variables are usually used as indicators of fiscal policy stance – the cyclically-adjusted primary balance (CAPB) or the structural balance (which was equal to the cyclically-adjusted one in the simulations because of no one-offs after 2017). Hence, changes in the CAPB and the structural balance were placed at the vertical axes, while the output gap – at the horizontal axes. In both cases the points are quite uniformly distributed and are not arranged around any line. The R-square coefficients, equal to approximately 2% and 0% respectively, confirm that, according to the simulations, there would be no significant relationship between cyclical conditions and fiscal policy stance in Poland. From that perspective, the SER seems to be acyclical rather than countercyclical.

The findings drawn by Jędrzejowicz, Kitala and Wronka (2009) and referring to the past outcomes were mixed. According to the authors, the fiscal policy in Poland in 1995-2003 was mostly procyclical. However, the correlation between the change in CAPB and the output gap suggested that the fiscal policy in 2004-2007 had been countercyclical which can be explained by the introduction of the Maastricht restrictions. As far as it regarded the negative output gaps, episodes of both expansionary and restrictive fiscal policy were recognised. On the other hand, positive output gaps implied usually deterioration of the CAPB. The authors put forward the thesis that the debt rule contributed to the procyclicality of the fiscal policy in Poland, because it used to trigger fiscal tightening during the economic slowdown.

Nevertheless, in order to investigate the issues of countercyclicality and long-term sustainability more thoroughly, more advanced methods than the visual analysis should be applied. Mackiewicz (2010) specified, among others, following methods of fiscal sustainability assessment: stationarity of public debt, stationarity of deficit (change in debt) and a fiscal reaction function.

Charts 11-12
Cyclicality of fiscal policy across 100 stochastic simulations in Poland 2014-2040


6%
4%
2%
0%
-2%
-4%
-6%
fiscal policy stance
(change in cyclically-adjusted primary balance
in pp of GDP)
y = -0.1151x + 0.0009
R² = 0.0162
-10%
-5%
0%
5%
10%
Cyclical conditions (output gap expressed in % of potential GDP)


6%
4%
2%
0%
-2%
-4%
-6%
fiscal policy stance
(change in structural balance in pp of GDP)
y = 0.0193x + 0.001
R² = 0.0006
-10%
-5%
0%
5%
10%
Cyclical conditions (output gap expressed in % of potential GDP)

The historically first method of assessing the fiscal sustainability was proposed by Hamilton and Flavin (1986) and consisted in verifying stationarity of public debt and balance. Testing for stationarity was necessary to prove that the limit of expected current debt value is non-positive:

$$\lim_{N\to\infty} E_t\left[(1+r)^{N} b_N\right] \leq 0 \qquad (18)$$

Where: r – debt interest rate, b – debt-to-GDP ratio.

Mackiewicz criticised this method due to the technical matters. The second method, introduced by Trehan and Walsh (1991), also deserves for some critical comments. This method consists in assessing stationarity of deficit which guarantees that debt-to-GDP can grow not more than a linear trend:

$$r_t b_{t-1} - s_t = b_t - b_{t-1} \sim I(0) \Rightarrow \lim_{j\to\infty} E_t\left(b_{t+j} \mid I_{t-1}\right) = b^{*}_{t-1} + (j+1)k \qquad (19)$$

Where: s – primary balance, I – information set, b* can be interpreted, according to Mackiewicz, as debt-to-GDP adjusted for a transitional component.

However, the consequent in the implication (19) is doubtful – it is not true that debt-to-GDP increasing in line with a linear trend is a symptom of stable fiscal policy. Sooner or later the level of debt would be too heavy a burden on the public finances because debt interest payments to GDP would increase as well, assuming the constant interest rate.

If r > 0, then primary balance (s) must be also positive in order to prevent debt from growing faster than GDP (k=0). According to Mackiewicz, r, defined in (20), should be indeed positive:

$$r_t = (R_t - y_t)/(1+y_t) \approx (1+I_t)/(1+\gamma_t) - 1 \geq 0\,. \qquad (20)$$

Where: R – real interest rate, y – real GDP growth, I – nominal interest rate, γ – nominal GDP growth.

Mackiewicz argued that *otherwise government would pay negative interest, in other words, such a state would gain profits from being indebted. In such an economy, any policy would have been sustainable, because any deficit could have been financed from future... negative interest.* With all due respect to the author of the very important and inspiring books for the Polish economists and policymakers (Mackiewicz, 2010), this is a false reasoning.

First of all, the government would pay negative interest if the nominal (rather than real!) interest rate (I instead of r in (20)) is negative. Secondly, it was common in Poland's history that nominal (real) GDP growth exceeded nominal (real) interest rate, so r was negative. This happened in 2011, 2008, 2007, 2006, 2004 and, moreover, this is expected by the European Commission for 2014 and 2015 in its spring 2014 update of the economic forecasts. Such a phenomenon is called 'growing out from the debt' and allows for reducing a debt-to-GDP ratio even without achieving primary surpluses.

Besides, if Polish debt was below 50% of GDP, while average bond yield was below 2% which are not very unrealistic assumptions, this would make possible to achieve the MTO (here nominal deficit at -1% of GDP) and a primary deficit at the same time. In such a case the fiscal sustainability would be respected, in line with the EU methodology, notwithstanding the primary deficit.

This last conclusion stems from the analysis of fiscal sustainability from the general perspective which does not require to introduce interest rates. Transformations (21) began with a definition of a debt as accumulated deficits. Then all variables were expressed as shares of GDP. Finally, a necessary condition for debt-to-GDP in the long run was obtained. Debt-to-GDP amounts to about deficit-to-GDP divided by the nominal GDP growth rate (all the variables should amount to their long-run levels or, in other words, steady states). As it can be seen, interest rates or primary deficit play no role in (21). If the long-run nominal GDP growth rate is assumed at the level of 4.1% projected for 2040 and the long-run deficit at the MTO level (1%), then the long-run debt will amount to about 25% of GDP, not far from the 18.9% observed in the deterministic projection (see the annex). Some other long-run debt-to-GDP ratios corresponding to the exemplary nominal GDP growth rates and nominal balances were presented in table 9.

$$B_{t+1}=B_t+D_{t+1}$$

$$\frac{B_{t+1}}{Y_{t+1}}=\frac{B_t}{Y_t(1+\gamma_t)}+\frac{D_{t+1}}{Y_{t+1}}\Rightarrow b_{t+1}=\frac{b_t}{1+\gamma_t}+d_{t+1}$$

$$b^*=\frac{d^*}{\gamma_t}(1+\gamma_t)\Rightarrow b^*\approx\frac{d^*}{\gamma_t} \qquad (21)$$

Where: D – level of the nominal deficit, B – level of debt, Y – GDP level, lower case letters stand for the variables divided by GDP.

Table 9
Ratios to which debt-to-GDP converge under the assumed nominal GDP growth rate and nominal balance (negative debt means accumulation of assets)

nominal GDP growth	balance = -3%	balance = -2%	balance = -1%	balance = 0%	balance = +1%
2%	153%	102%	51%	0%	-51%
3%	103%	69%	34%	0%	-34%
4%	78%	52%	26%	0%	-26%
5%	63%	42%	21%	0%	-21%
6%	53%	35%	18%	0%	-18%

To sum up, primary surpluses are not necessary to stabilise debt-to-GDP at the safe level. A citation from Jajko (2008) might serve as a summary of the discussion on the sign of r: *In a research on fiscal sustainability, one often assumes that the real interest rate is in principle, or at least in the medium and long term higher than the real GDP growth rate. Adopting a different assumption (y>r) would mean that primary* *surpluses would not be necessary for meeting a budget constraint, because they would lead to a decrease of debt-to-GDP. In such a case primary deficits would be permissible.*

The two methods of the assessment of fiscal sustainability, whose several aspects have just been discussed, had been applied to the results of one thousand stochastic simulations. In table 10, p-values of three panel unit root tests were presented. All of them included individual intercepts but no trend. ADF tests consisted of 2 lags of the explained variable. All those assumptions were consistent with the methodology adopted by Mackiewicz. The equation used in the ADF test for each cross section was presented in formula (22).

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + \varepsilon_{it} \tag{22}$$

The hypotheses made in the tests were as follows:

$$\begin{aligned} H_0 &: \quad \alpha_i = 0 \quad \forall_i \\ H_1 &: \quad \begin{matrix} \alpha_i = 0 & \text{for } i = 1,2,\dots,N_1 \\ \alpha_i < 0 & \text{for } i = N_1+1, N_1+2,\dots,N \end{matrix} \end{aligned} \tag{23}$$

Therefore, all the tests shown in table 10 were only able to separate the realisations of processes which had individual unit roots in all cross sections (simulations) from those which had some stationary cross sections. Public debt level was definitely non-stationary, whereas change in public debt and a similar indicator – primary balance might have been at least in some cases stationary.

Table 10: Panel unit root tests performed on 1000 simulated scenarios (p-values)

Test	Statistic	public debt level	change in public debt	primary balance
Im, Pesaran & Shin	W	0.999	0.000	0.000
Fisher-ADF	Chi-sq	0.881	0.000	0.000
Fisher-PP	Chi-sq	1.000	0.000	0.000

Table 10 was then not informative enough, if one expected to know what the exact estimated number of stationary cross sections is. Table 11 filled this gap. It presents a fraction of the simulated scenarios in which stationarity was detected at the intermediate stage of individual ADF and PP tests, at the significance level of 1, 5 and 10%. Apparently, there is a difference between public debt level and two other indicators but in the vast majority of simulations no stationarity in considered variables was detected.

Table 11: Fraction (in %) of scenarios in which a given unit root test indicated p-values below 1, 5 or 10% (null hypothesis – unit root)

Test	public debt level			change in public debt			primary balance		
p-value	1	5	10	1	5	10	1	5	10
Im, Pesaran & Shin Fisher-ADF	0.4	4.0	9.6	3.4	20.2	33.0	2.4	15.0	27.8
Fisher-PP	0.0	0.0	0.0	7.6	24.6	41.8	8.0	27.4	41.0

4.3. Fiscal reaction function before and after the SER

Taking into account the reservations to the methods laid in subchapter 4.2, conclusions which might be drawn from the outcomes of the tests are ambiguous. Hence, another method assessing fiscal sustainability and procyclicality simultaneously – a fiscal reaction function (FRF) was investigated and turned out to be more fruitful. The FRF is a model explaining a variable which stands for the fiscal stance (e.g. the primary or structural balance) by variables reflecting the state of public finances or the economic situation. One can interpret the fiscal policy in a given country by analysing significance and sign of the coefficient values for the explaining variables, unless the goodness of fit of the model is unacceptable.

Four kinds of the fiscal reaction functions were presented in tables 12-13. Two of them were estimated on the Polish historical data: the original one proposed by Mackiewicz (2010) and the one updated by the author of the following paper. The third was estimated on the results of the deterministic projection. All three were collected in table 11. The remaining one was estimated on the results of the stochastic simulations and was presented in four variants in table 13.

In the first FRF (equation (24)), the primary balance was used as the explained variable, while the output gap was one of the explanatory variables. Otherwise, if the structural balance had been the explained variable, it would have been impossible to grasp any reaction of the fiscal policy on fluctuations of a business cycle. However, the primary balance in (24) referred only to the state budget. The balance was admittedly adjusted in order to make the data comparable across time, e.g. for a deficit in the Social Security Fund resulting from the transfers of the contributions to the Open Pension Funds (OFE) and for the costs of the National Health Fund which were incurred by the state budget before the reform of the healthcare system. Nevertheless, the general government balance better reflects an overall state of public finances. In this subchapter, GG balance was indeed used in the remaining FRFs (equations (25)-(30)).

According to the FRF specified and estimated by Mackiewicz, the fiscal policy in Poland between 1993 and 2008 was not only countercyclical but also sustainable: *Institutions in Poland forced an increase of the primary surplus as the reaction to the increasing level of the public debt*. These conclusions were derived from the significant positive parameter values for the output gap and the public debt in equation (24). On the other hand, one can find several opposite findings in subchapter 1.

Equation (25), estimated on the historical data from 1997 to 2013, with the slightly different dependent variable, much more different output gaps (after all revised strongly due to the crisis) and without any dummy variables, showed no significant relationship between the explained and the explanatory variables. Apparently, the primary balance before the SER was formed in such a discretionary way that is now difficult to be gauged against the most common macroeconomic indicators. What is more, the coefficient of determination was exceptionally low, while the regression residuals underlay a process of autocorrelation. This latter was detected by Ljung-Box and Breusch-Godfrey tests, both with three lags of the explained variable – consistently with Mackiewicz's approach, though he also used five lags in a chapter about cross-country comparison.

Regression (26), ran on the deterministic projection, although better fitted to data, still did not show any clear pattern between the variables with the exception of the autoregressive dependence. It is worth reminding, that the output gap cannot have been included in this equation because the projection had assumed no cyclical fluctuations in the economy.

Table 12: Estimation results of the fiscal reaction functions (FRF)

	(24)	(25)	(26)
	Mackiewicz (2010)	FRF updated	Deterministic projection
Explained variable	Primary budget balance	Primary GG balance	Primary GG balance
Period	1993-2008	1997-2013	2015-2040
Included observations	15	16	26
Estimation method	OLS	OLS	OLS
Dummy variable	Irrelevant after 2008	-	-
Output gap	0.454**	0.149	-
	0.070	0.140	
Lagged explained variable	-0.004	0.343	0.741***
	0.103	0.299	0.094
Public debt	0.049***	-0.073	0.010
	0.012	0.076	0.008
Constant	-0.012	0.023	0.000
	0.008	0.032	0.003
Adjusted R^2	0.740	0.292	0.765
ADF test	-3.504***	-3.451**	-1.979
p-value (ADF)	0.008	0.029	0.294
Ljung-Box Q-statistic (3 lags)	5.994	10.654**	28.472***
p-value (Q)	0.112	0.014	0.000
Breusch-Godfrey LM test (3 lags)	-	10.123**	18.286***
p-value (LM)	-	0.017	0.000
Jarque-Bera test	1.978	2.787	1.039
p-value (JB)	0.372	0.248	0.594

Table 13: Estimation results of the fiscal reaction functions (FRF) based on the stochastic simulations

	(27)	(28)	(29)	(30)
Explained variable	Primary GG Balance	Primary GG balance	Primary GG Balance	Primary GG balance
Period	2017-2040	2017-2040	2019-2040	2021-2040
Included observations	24000	24000	22000	19000
Estimation method	Arellano-Bond dynamic panel			
Instruments for differenced equation	Output gap (-2, -3, -4), Primary balance (-2, -3, 4)	Output gap(-2, -3, -4, -5), Primary balance (-2, -3, -4, -5)		
Primary GG balance (-1)	0.401***	0.437***	0.418***	0.375***
	0.016	0.015	0.017	0.019
Primary GG balance (-2)	0.046***	0.055***	0.048***	0.057***
	0.008	0.008	0.008	0.008
Output gap	0.318***	0.287***	0.308***	0.353***
	0.015	0.013	0.017	0.019
Public debt	0.139***	0.130***	0.139***	0.159***
	0.007	0.006	0.008	0.009
Constant	-0.045***	-0.042***	-0.044***	-0.049***
	0.002	0.002	0.003	0.003
R-square	0.066	0.097	0.081	0.053
Arellano-Bond test for zero autocorrelation in first-differenced errors (p-value)				
2nd order	0.205	0.651	0.086*	0.957
3rd order	0.486	0.541	0.679	0.971
4th order	0.424	0.319	0.269	0.183
5th order	0.925	0.999	0.823	0.468

Table 13 constitutes one of the most important outcomes in the present paper, because it highlights the crucial features of the fiscal policy conducted under the SER. The FRFs, labelled as regression (27)-(30) were estimated by the dynamic panel Arellano-Bond generalised method of moments, on the dataset coming from the stochastic simulations. The specification of all equations was the same as in the case of the deterministic projection with the exception of the additional second lag of the explained variable. The only difference between the equations consists in the starting years of the estimation periods. Due to the lags in the instruments, it would be impossible to set the starting point before 2017.

Regression 27 met all substantial criteria which are required from the properly modelled fiscal reaction function. Not only was the regression reliable from the technical perspective (lack of the autocorrelation) but it was also meaningful from the economic point of view. The primary balance turned out to be positively dependent, in statistical terms, on the output gap and the public debt. It would mean that the fiscal policy conducted according to the stabilising expenditure rule would be countercyclical and sustainable. The only fly in the ointment was the rather poor coefficient of determination but in general the robustness check confirmed the findings based on regression (27).

The robustness check consisted in running three additional regressions. The specification was the same in all equation but they were estimated with different number of the instruments and had different starting years of the sample. For clarity, one should add that the inference from regression (29) would be unfounded if the significance for the Arellano-Bond test for autocorrelation was assumed at the level of 10%. Anyway, apart from the mentioned exception, the results of estimation for all equations were very similar which confirmed countercyclicality and sustainability of the SER.

5. Summary

In general, according to the stochastic simulations, the GG debt will diminish in relation to GDP from about 50% in 2014 slowly to 40% in 2020's and will continue the downward trend, toward about 20% in 2040. In the near future, a structural change might occur in 2016. According to the projection, net public debt will then amount to a little less than the lower threshold (43% of GDP). Any slight negative deviation from the baseline deficit in that year would lead to the correction.

Three technical remarks should be recalled here. Firstly, if a more pessimistic GDP projection, e.g. prepared by the Ageing Working Group, was assumed, then the debt would go down slower. Secondly, more importantly, there was assumption behind the simulations that revenue oscillated around the fixed level expressed in % of GDP. In practice, some revenue categories and measures amounting to below 0.03% of GDP are not classified as the discretionary revenue measures in the SER. This provides some space for the active revenue policy which may counteract the passive expenditure policy in the short run. Nevertheless, the space is limited, because excessive deviations from the MTO have to be removed. Also the active expenditure policy is possible but only if it is more restrictive than implied by the SER. Thirdly, if the SER is assessed as too restrictive in the long run, the MTO might also be slightly relaxed (without violation of the EU requirements), so that the downward trend in public debt might be eventually stopped.

The results of the simulations show that the corrections will be applied even in the long run, due to forecast errors among other factors, assuming similar magnitude of errors as in the past. CPI forecasts errors are adjusted continuously in the formula of the SER but their impact on a single year cannot be neglected. The forecasts errors in real GDP growth rates play less important role because they are included into 8-year mean. However, such errors can be adjusted only indirectly, via the correction mechanism, which is triggered only in the case of the imbalance in public finances. It should be emphasised that if either inflation forecast errors are large, or the correction mechanism is applied too frequently, then volatile expenditure dynamics will make long-term planning more difficult.

One of the triggers embedded in the mechanism refers to the excessive deficit. From the statistical point of view, even if the structural balance remains at the MTO level, the nominal deficit will still exceed 3% of GDP once per 25 years. The simulations indicated that in practice the deficit will be higher than 3% of GDP as often as on average once every six-seven years unless the active and effective revenue policy is conducted. Still, this would be huge improvement compared with the time before 2014 and taking into account that the SER is the >>expenditure<< rule rather than the nominal or structural balance one.

According to *Plan for the Development…* a fiscal rule should prevent the excessive deficits. Similarly, *the sum of differences* between a nominal balance and the MTO should ideally oscillate in the ±6%-of-GDP range. According to the stochastic simulations, *the sum of differences* may deviate significantly from the ±6% thresholds. However, thanks to the correction mechanism, the negative deviations are reduced over time.

The debt thresholds were lowered in the SER's correction mechanism by 7 pp due to the pension system reform. This amendment to the SER has already been included in the baseline scenario in the present paper. If there had been no change in the thresholds, the future of public finances would not be much different. In 2040 the level of public debt would be nearly the same under the both assumptions. In the short run however, the timing of the corrections would differ. The higher thresholds would lead to no correction in 2017, contrary to the scenario with the lower thresholds. This, in turn, would advance another period of the correction by 5 years. As the SER has been introduced before the MTO is achieved, the correction in 2017 would contribute to tightening the deficit, so that it can reach the MTO already in 2018. Otherwise, the MTO would be achieved much later, in 2022.

An appropriate fiscal policy should be countercyclical and sustainable. There was virtually no correlation between the primary balance and the output gap in the baseline stochastic simulations which indicates 'acyclicality' of the rule. Besides, unit root tests mostly indicated no stationarity of a primary balance which, from the theoretical perspective, may put the sustainability of the SER into the question. Nevertheless, a fiscal reaction function, which is the more reliable method than the aforementioned ones and which was estimated on the data obtained from the stochastic simulations, proved countercyclicality and sustainability of the new fiscal rule after the transition period, during which the structural balance was assumed to converge to the MTO.

To sum up, the stabilising expenditure rule will change restrictiveness and cyclicality of the fiscal policy in Poland and may make the public finances more sustainable.

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Annex: Deterministic projection for Poland, 2014-2040

	Real GDP growth	8-year average real GDP growth	CPI inflation = GDP deflator	Discretionary change in GG revenue	GG revenue
2014	3.3%	3.3%	1.2%	4929	35.6%
2015	3.8%	3.8%	2.3%	3900	36.4%
2016	4.3%	4.3%	2.5%	-525	36.3%
2017	4.3%	4.3%	2.2%	-5367	36.0%
2018	4.1%	4.1%	2.4%	0	36.0%
2019	3.8%	3.8%	2.4%	0	36.0%
2020	3.3%	3.3%	2.4%	0	36.0%
2021	3.2%	3.2%	2.4%	0	36.0%
2022	3.1%	3.1%	2.4%	0	36.0%
2023	3.0%	3.0%	2.3%	0	36.0%
2024	2.9%	2.9%	2.3%	0	36.0%
2025	2.8%	2.8%	2.3%	0	36.0%
2026	2.8%	2.8%	2.3%	0	36.0%
2027	2.8%	2.8%	2.3%	0	36.0%
2028	2.8%	2.8%	2.2%	0	36.0%
2029	2.7%	2.7%	2.2%	0	36.0%
2030	2.7%	2.7%	2.2%	0	36.0%
2031	2.6%	2.6%	2.2%	0	36.0%
2032	2.6%	2.6%	2.2%	0	36.0%
2033	2.6%	2.6%	2.1%	0	36.0%
2034	2.6%	2.6%	2.1%	0	36.0%
2035	2.5%	2.5%	2.1%	0	36.0%
2036	2.5%	2.5%	2.1%	0	36.0%
2037	2.4%	2.4%	2.1%	0	36.0%
2038	2.3%	2.3%	2.0%	0	36.0%
2039	2.2%	2.2%	2.0%	0	36.0%
2040	2.1%	2.1%	2.0%	0	36.0%

	GG expenditure	GG balance	Sum of differences	GG debt	Correction in the SER
2014	39.6%	-3.5%	-2.5%	50.0%	-2.0%
2015	38.9%	-2.5%	-4.0%	49.7%	-2.0%
2016	38.0%	-1.8%	-4.7%	48.3%	-2.0%
2017	37.2%	-1.2%	-5.0%	46.5%	-1.5%
2018	36.8%	-0.8%	-4.8%	44.4%	0.0%
2019	36.7%	-0.7%	-4.4%	42.5%	0.0%
2020	36.8%	-0.8%	-4.2%	40.9%	0.0%
2021	37.0%	-1.0%	-4.2%	39.7%	0.0%
2022	37.2%	-1.2%	-4.3%	38.8%	0.0%
2023	37.4%	-1.4%	-4.7%	38.2%	0.0%
2024	37.6%	-1.6%	-5.4%	37.9%	0.0%
2025	37.8%	-1.8%	-6.1%	37.8%	0.0%
2026	37.9%	-1.9%	-7.0%	37.8%	0.0%
2027	37.4%	-1.4%	-7.5%	37.4%	-1.5%
2028	36.9%	-0.9%	-7.4%	36.5%	-1.5%
2029	36.4%	-0.4%	-6.8%	35.2%	-1.5%
2030	36.0%	0.1%	-5.7%	33.5%	-1.5%
2031	35.5%	0.5%	-4.2%	31.4%	-1.5%
2032	35.5%	0.5%	-2.7%	29.5%	0.0%
2033	35.6%	0.5%	-1.3%	27.7%	0.0%
2034	35.6%	0.4%	0.2%	26.0%	0.0%
2035	35.6%	0.4%	1.5%	24.5%	0.0%
2036	35.7%	0.3%	2.9%	23.0%	0.0%
2037	35.7%	0.3%	4.2%	21.7%	0.0%
2038	35.8%	0.2%	5.4%	20.6%	0.0%
2039	35.9%	0.1%	6.5%	19.7%	0.0%
2040	36.0%	0.0%	7.5%	18.9%	0.0%