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REPUBLIC OF POLAND

SELECTED ISSUES

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A FINANCIAL CONDITIONS INDEX FOR POLAND[1]

This paper constructs a financial conditions index for Poland to explore the link between financial conditions and real economic activity. The index is constructed by applying two complementary approaches—factor analysis and vector auto-regression approach. While FA is a purely statistical exercise aiming at extracting the "common factor" from a wide range of financial variables, the VAR method allows us to express the FCI in terms of its contribution to near-term GDP growth. We evaluate the index's forecasting performance against a composite leading indicator developed by the OECD. We found that the FCI is highly correlated with GDP growth, attesting to the importance of financial sector in Poland's economy. By combining information from various domestic and external financial indicators, the constructed FCI tracks GDP growth better than any individual indicators. In-sample and out-of-sample forecasting exercises indicate that the FCI can outperform the CLI in predicting near-term GDP growth.

A. Introduction

1. This paper presents a financial conditions index (FCI) for Poland to explore the link between financial conditions and real economic activity. The FCI combines a wide range of high-frequency financial variables, including external variables, to assess aggregate financial conditions in the economy. The index helps to identify and assess macro-financial linkages and provides a historical perspective in comparing the relative tightness and looseness of financial conditions. It is also useful for the conduct of monetary policy since it captures important channels of monetary transmission, and thus can be used by the monetary authority to gauge the potential impact of monetary policy decisions on the real economy. By including external financial variables in the construction of the FCI, the FCI can capture external spillovers on domestic financial conditions and economic activity. Finally, the FCI may also have forecasting power in pointing to the direction of near-term economic activity, and therefore can be used as an input in macroeconomic forecasting models.

2. We construct the FCI for Poland based on two complementary methods, i.e., vector auto-regression (VAR) and factor analysis (FA). These methods follow recent work on FCIs.[2] While FA is a purely statistical exercise aiming at extracting the "common factor" from a wide range of financial variables, the VAR method allows us to express the FCI in terms of its contribution to near-term GDP

[1] Prepared by Giang Ho and Yinqiu Lu.

[2] See e.g. Swiston (2008), Hatzius and others (2010) for the United States, Onsorio and others (2011) for Asia, Hofman (2011) for Russia, and Gumata and others (2012) for South Africa.

growth. We evaluate the index's forecasting performance against a composite leading indicator (CLI) developed by the OECD. [3]

3. We find that the constructed FCI for Poland by either method is highly correlated with GDP growth. Among the domestic financial variables, the WIBOR rate, bank lending standards, and the corporate loan spread contribute most to the overall FCI. External variables such as VIX volatility index or EURIBOR-OIS spread are also very important, particularly during the global financial crisis, as they have both a direct and indirect impact on growth (the latter through their influence on domestic financial conditions). In-sample and out-of-sample forecasting exercises indicate that the FCI can outperform the CLI in predicting near-term GDP growth, i.e. two-quarter horizon.

4. The paper is organized as follows. Section B provides an overview of the methodologies for calculating the FCI. Section C presents the index constructed from the VAR and FA, and discusses recent developments. Section D evaluates the FCI's forecasting properties, and Section E concludes.

B. Overview of Methodology

Vector Auto-Regression

5. Using the VAR method, the FCI is calculated as:

$$FCI_t = \sum_{j=1}^{n} \omega_j (x_{jt} - \overline{x_j})$$

In this formulation, the FCI in each period t is a weighted average of n different financial variables denoted by x_{jt}, where ω_j denotes the weight, and $\overline{x_j}$ denotes the variable mean over the sample period (2004Q1–2012Q4). [4] Thus, financial variables enter the FCI as deviations from the mean, which represent shocks to the variables at each point in time.

6. The financial variables entering the FCI are chosen based on their significant impact on GDP growth, estimated through an exploratory process similar to Swiston (2008). In particular, the weight of each variable (ω_j) is the cumulative two-quarter impulse response of GDP growth to a one-unit shock to x_{jt}. It is estimated from a recursive VAR model consisting of all the financial variables, plus quarterly GDP growth and the GDP deflator. This weight thus measures the relative importance of each financial variable in terms of its impact on growth. The identification of structural shocks is achieved through a Cholesky decomposition (more detail below). The FCI weights will reflect the

[3] The CLI for Poland is constructed from 5 component series: real effective exchange rate, 3-month WIBOR, manufacturing production, unfilled job vacancies, and production of coal. According to the OECD, these are the series that exhibit leading relationship with GDP at turning points of business cycle.

[4] We do not use time-varying means since our sample is relatively short, which mitigates the concern over possible structural changes in the economy. For example, by 2004 Poland has gone through the disinflation process and established a constant inflation target.

impact of "pure" structural shocks on growth to the extent that the recursive identification scheme is successful.

7. The main advantage of a VAR-based FCI over other methodologies is its ability to account for the interdependent relationships among financial variables. For example, the impact of monetary policy tightening includes both the direct effect of higher interest rates on economic activity and indirect effects through the impact of higher interest rates on other financial market variables that in turn affect growth.

Factor Analysis

8. FA can be used to extract an unobserved common factor that captures the greatest common variation in a group of financial variables. Specifically:

$$X_t - \mu = \beta F_t + U_t.$$

In this formulation, X_t is a vector of financial variables, μ denotes a vector of variable means, F_t is the common factor (unobserved), and U_t is a vector of errors assumed to be orthogonal to the common factor. Financial variables are chosen for their potential impact on growth (from VAR analysis), but also based on their estimated factor loading, i.e. correlation with the common factor.

9. The common factor summarizes the information contained in current financial variables. Following Onsorio and others (2011), to obtain the FCI, we purge the common factor of any influence of past economic activity by regressing F_t on current and lagged growth:

$$F_t = A(L)y_t + \varepsilon_t,$$

where $A(L)$ is the lag operator and y_t denotes the year-on-year GDP growth rate. The error term, ε_t, will be our factor-based FCI, which captures only exogenous developments in financial conditions that predict future economic activity.

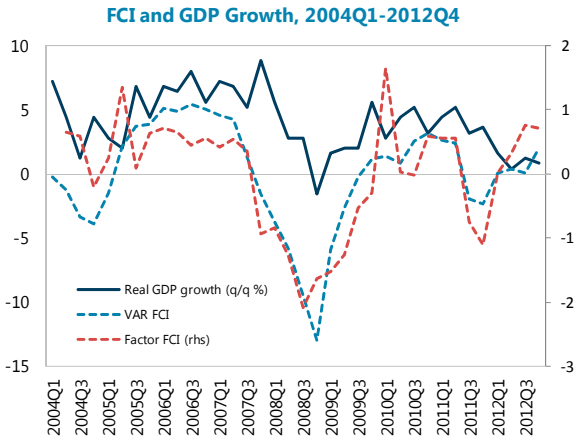
C. A Financial Conditions Index for Poland

Overview of the Constructed FCIs

10. The two measures of FCI constructed from VAR and FA are highly correlated with each other, with a correlation of 0.78. An increasing index indicates easing financial conditions, while a decreasing index implies tightening.

11. The FCI is highly correlated with GDP growth, attesting to the importance of financial sector in Poland's economy (text chart). For example, the contemporaneous correlation of the VAR-based FCI with annualized quarter-on-quarter growth over the period 2004Q1-2012Q4 is 0.56, and

the correlation with two-quarter-ahead growth is 0.67. The factor-based FCI is uncorrelated with contemporaneous growth by definition, being the residuals of the regression on current and past growth rates. However, it is highly correlated with *future* growth, e.g. correlation with four-quarter-ahead growth rate is 0.52, suggesting potential forecasting power.



12. The VAR-based FCI is measured in terms of contribution to growth, which facilitates intuitive interpretation. For example, between 2007Q4 and 2009Q3, the FCI contributed on average -5¼ percentage points per quarter to annualized QoQ growth. At the trough of the financial crisis (2008Q4), the economy contracted by 1.6 percentage points (in annualized term), of which adverse financial conditions contributed almost -13.0 percentage points. In other words, not only the direction of change (easing or tightening) in the FCI matters but also its level. This allows us to pinpoint, for example, periods in which financial conditions are tightening (decreasing FCI) but still contributing to growth (positive FCI).

13. The FCI produced by FA is in a way less intuitive, since it does not take into account the relationship among financial variables or their impact on growth. FA is purely a statistical exercise aimed at extracting as much common variance among the data as possible. The resulting common factor represents an unobserved force driving movements in financial variables, but one that is difficult to attach a meaning to. Nevertheless, an advantage of FA over VAR is that there are fewer constraints in the number of variables that can be included, enabling us to potentially cover a wider spectrum of financial market developments.

VAR-Based FCI

14. We include both domestic and external financial variables in the FCI. Domestic variables include lending standards from the Senior Loan Officer Opinion Survey (average across corporate loan categories),[5] 3-month WIBOR rate, corporate loan spread,[6] 5-year government bond yield, and the real effective exchange rate (REER). These variables capture various channels through which monetary

[5] Lending standards are measured in terms of percent balance (difference between the percentage of surveyed banks easing standards and those tightening standards). The survey is administered quarterly by the National Bank of Poland. The loan categories include long-term loans for large enterprises, short-term loans for large enterprises, long-term loans for small and medium enterprises, and short-term loans for small and medium enterprises. Standards for household loans are excluded due to their limited impact on growth.

[6] This is the spread between the lending rate for non-financial corporations and the policy interest rate.

policy affects the real economy (interest rate, exchange rate, credit, and asset prices).[7] External variables include the EURIBOR-OIS spread and the VIX index, which represent external financial conditions that would likely affect Polish economy via its banking exposure to Europe and reliance on external financing.

15. The identification of structural shocks is achieved through a Cholesky decomposition, which assumes that domestic financial conditions do not have contemporaneous effects on growth and inflation, and that domestic developments (real and financial) do not contemporaneously affect external variables. Specifically, we employ the following Cholesky ordering, similar to Swiston (2008): VIX, EURIBOR-OIS, GDP growth, GDP deflator, lending standards, WIBOR, REER, corporate loan spread, government bond yield. The rationale for the ordering among domestic financial variables is the relative sluggishness of the variable; for example, bond yields, corporate lending rates, and REER are relatively fast-moving financial indicators, while the WIBOR rate adjusts to follow the policy interest rates which are set by the Monetary Policy Council, and lending standards are updated every quarter.[8]

16. By combining information from various financial indicators, the constructed FCI tracks GDP growth better than any individual indicators (Table 1). The VAR-based FCI also tends to correlate the most with one- and two-quarter ahead growth rates, suggesting potential predicting power for near-term growth. Among the domestic financial variables, lending standards have the highest contemporaneous correlation with GDP growth, while real exchange rate and government bond yield are more related to future growth. External variables (VIX and EURIBOR spread) are also highly correlated to Poland's growth, reflecting Poland's extensive links with Europe and the world not only through the banking system but also in trade.

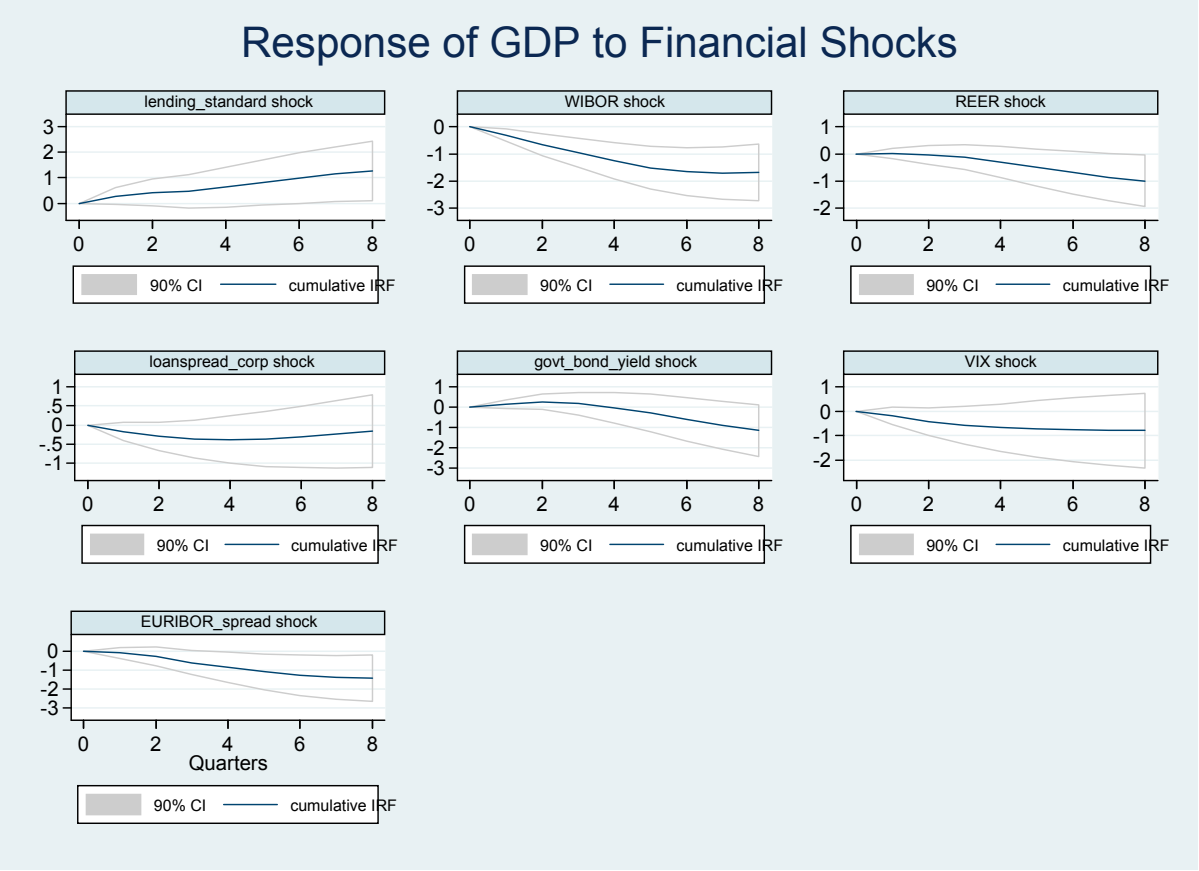
Table 1. Correlations Between Financial Variables and Real Activity, 2004Q1–2012Q4

	Real GDP (annualized QoQ percent change)				
Variable	t	t+1	t+2	t+3	t+4
FCI	**0.56**	**0.66**	**0.67**	**0.55**	**0.31**
Lending standards	0.46	0.40	0.30	0.10	0.13
3-mo WIBOR	-0.35	-0.46	-0.45	-0.32	-0.08
Real exchange rate	0.03	-0.06	-0.10	-0.31	-0.26
Corporate loan spread	-0.37	-0.27	-0.26	-0.24	-0.25
Government 5-yr bond yield	-0.04	-0.26	-0.38	-0.36	-0.25
EURIBOR spread	-0.36	-0.46	-0.57	-0.64	-0.51
VIX	-0.37	-0.42	-0.50	-0.43	-0.40

[7] We fail to find a significant relationship between GDP growth and equity prices, possibly due to the relatively low level of stock market capitalization in Poland.

[8] The results are quite robust to varying the order among domestic financial variables.

17. The text chart below shows the impulse responses of GDP growth to a one-standard-deviation shock in various financial variables, estimated from the VAR model specified above. All responses have the expected sign and most are statistically significant. For example, a 20 basis point increase in the interbank lending rate (WIBOR) is estimated to reduce annualized QoQ growth by roughly 0.3 percentage points in the first quarter, accumulating to over 1½ percentage points after two years. To the extent that the WIBOR rate closely follows the policy reference rate, this suggests a prominent role of Poland's monetary policy in influencing the real economy. Lending standards also have a significant growth impact: a tightening of average lending standards by one standard deviation (roughly 10 percentage points) is expected to cumulatively reduce growth by 1¼ percentage points in two years.[9] An increase in government bond yield and a REER appreciation both hurt growth in the longer run (two to three quarters after shock), but unlike other financial variables their impacts are not immediate.



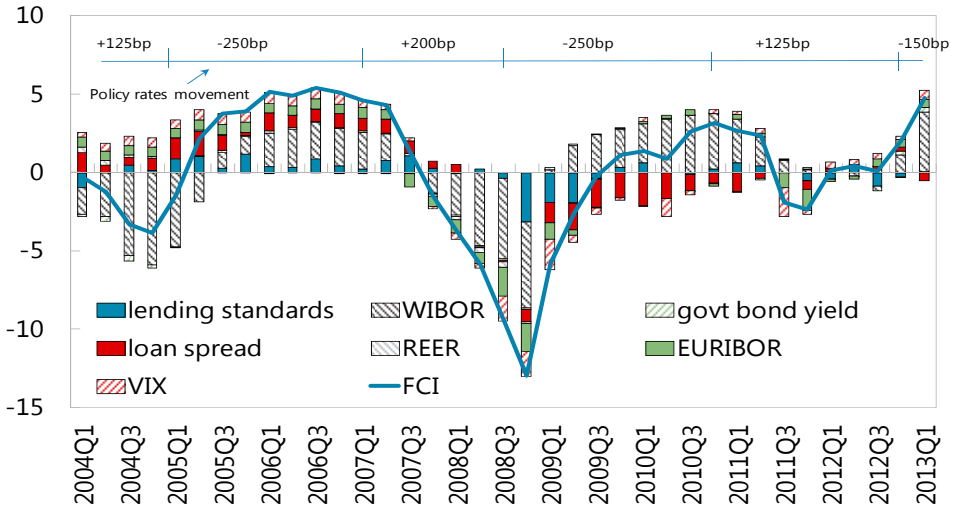
[9] As a benchmark comparison, lending standards (average across all corporate loan categories) tightened by about 86pp in 2009Q1.

18. The FCI can be decomposed into relative contributions of various financial variables over the period 2004Q1–2013Q1 (Figure 1).[10] The contribution of each variable at each point in time is determined by not only its shock at the time but also its estimated impact on growth (or its weight in the FCI). The weights are computed from the impulse responses of growth to various financial shocks presented above. Given the way that the FCI is constructed in this paper, the contribution of each variable is its cumulative contribution to growth after 2 quarters. In other words, if monetary easing takes place at t, then the FCI shows the cumulative growth impact of this easing measured at t+2.

19. Among the domestic variables, the most significant contributions come from WIBOR, the corporate loan spread, and lending standards. These three variables together contributed on average almost 3 percentage points per quarter in annualized QoQ GDP growth[11] between 2005Q2 and 2007Q3, when financial conditions were favorable (having positive impact on growth). Indeed, the National Bank of Poland (NBP) entered an easing cycle in 2005Q2 and by 2007Q1 had reduced the policy rate by 250bps, during which time the WIBOR rate closely followed. Lending standards were eased and the spread on corporate loans declined, adding to the favorable conditions. During 2007, a tightening cycle was started by the NBP, and the FCI started to decrease but was still positive, reflecting financial conditions that were tightening but still having positive contribution to growth.

Figure 1. Contributions to FCI, 2004Q1-2013Q1

(percentage points of annualized q/q growth)



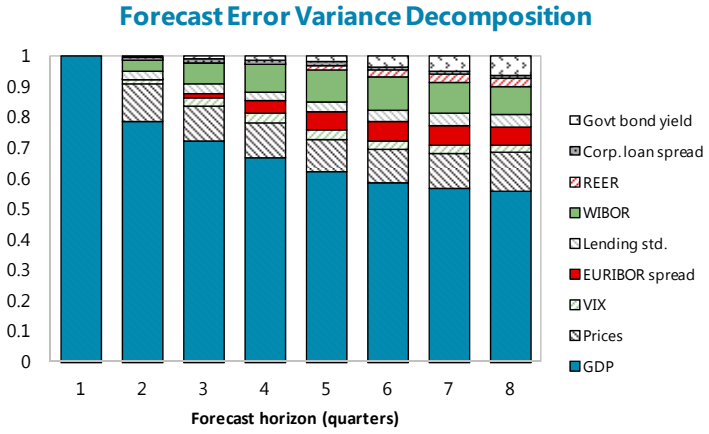
Sources: Haver and IMF staff estimates.

[10] The decomposition of 2013Q1 is calculated based on the weights calculated over the period of 2004Q1–2012Q4.

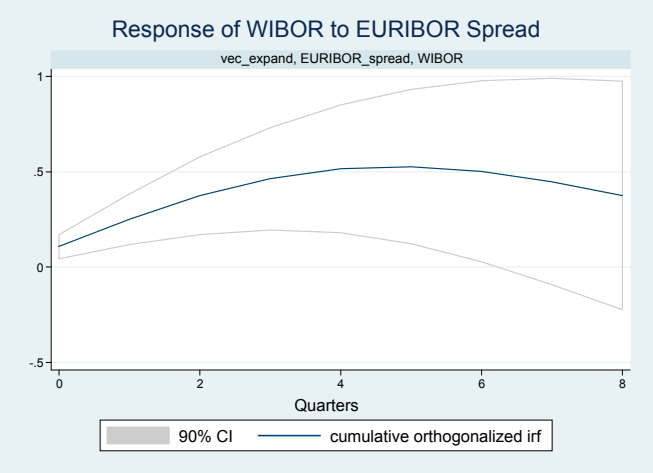
[11] This is the cumulative two-quarter impact on growth.

20. Between 2007Q4 and 2009Q2, the WIBOR rate, corporate loan spread and lending standards together contributed on average -3¾ percentage points per quarter to growth. During 2008, the bulk of negative contribution was from WIBOR, which increased by 90bps between Q1 and Q4 (more than the cumulative hike in policy rates), mainly reflecting a sudden freeze of liquidity in the interbank market. In response to the crisis, the central bank then cut the policy rate by 250bps between end-2008 and end-2009, alleviating pressure on the WIBOR and contributing to the recovery. Pressures from the interbank market were transmitted to the credit market, which then impacted GDP growth with a lag. Therefore, it was not until late 2008–early 2009 that tight lending standards and rocketing corporate loan spread started to prove onerous to growth.

21. External financial conditions also feature prominently in Poland's FCI. In particular, the VAR-based FCI includes the VIX volatility index, which captures general global risk sentiment ("fear index"), and the EURIBOR-OIS spread, which captures liquidity conditions in the euro area's interbank market from which many parent banks of Polish financial institutions get their funding. Both external indicators were acutely affected at the time of the Lehman collapse, and between 2008Q3 and 2009Q1 contributed on average -3¼ percentage points per quarter to Poland's GDP growth, almost as much as the total impact of the three leading domestic variables. An examination of the forecast error variance decomposition shows that about 10 percent of the error in Poland growth forecast eight quarters out is due to shocks to VIX and EURIBOR-OIS spread (text chart).

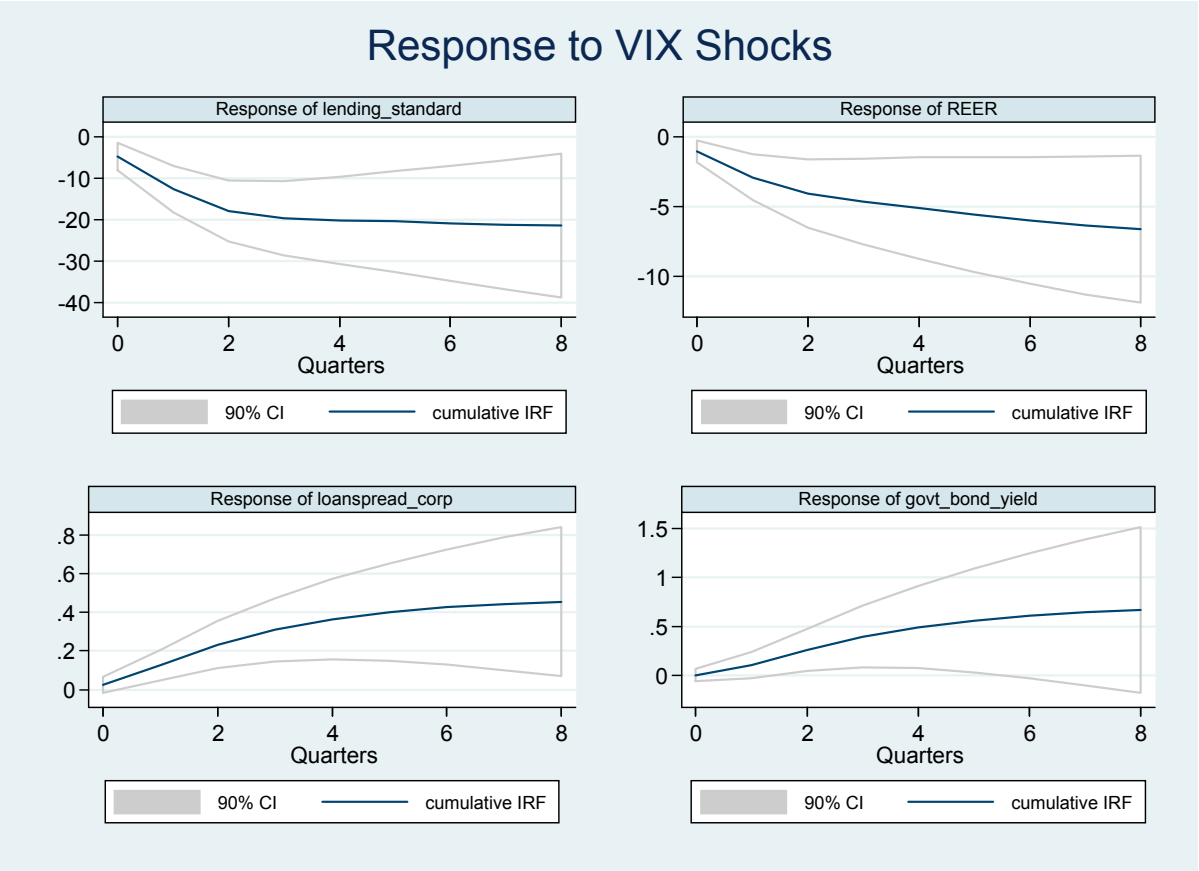


22. The VIX index and EURIBOR-OIS spread affect growth in Poland partly through their impact on domestic financial conditions. For example, the 3-month WIBOR is very responsive to movements in the EURIBOR-OIS spread, reflecting the large exposure of Poland's financial sector to banks in the euro area. The VIX volatility index does not significantly affect WIBOR, but has large and statistically significant impact on other financial variables (text chart). A worsening of global risk sentiment as indicated by a VIX increase is associated with tightened lending standards, higher spread on corporate loans, depreciation of the real exchange rate, and



an increase in the government bond yield (text chart).

23. Which aspect of financial conditions is constraining growth at the current juncture can be inferred from the relative contributions of FCI components. Conditions were favorable between early-2010 and mid-2011 mainly on account of low WIBOR rate, but also due to improved external conditions and lending standards that were either neutral or easing. 2011Q3 and Q4 saw a sharply deteriorating FCI due almost entirely to external factors (widening VIX and EURIBOR-OIS spread) related to renewed sovereign and financial stress in peripheral Europe. Latest data show that aggregate financial conditions have started to ease and are again contributing positively to growth. This is due partly to improved external financial conditions, but mainly to easing monetary conditions (the NBP started an easing cycle in November 2012, and the policy rates were cut by a cumulative 150bps by March 2013).

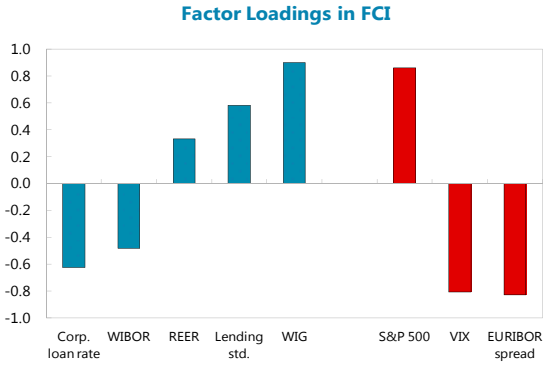


Factor-Based FCI

24. Similar to the VAR framework, we include both domestic and external financial variables in the factor-based FCI. These include lending standards, WIBOR, corporate loan rate, REER, and WIG

stock index for domestic variables, and VIX, EURIBOR-OIS spread, and S&P 500 stock index for external variables.[12] They are chosen for their potential impact on growth (from VAR analysis), and as in usual practice, also based on their correlation with the common factor (at least 30 percent).The set of financial indicators included in the factor-based FCI broadly coincides with that used in the VAR method, except for the inclusion of the stock price indices.

25. The relative "weight" of each variable in the factor-based FCI is captured in the estimated factor loadings (text chart)**.** When there is a single factor extracted, as is the case here, the factor loading is equivalent to the correlation between the variable and the common factor. For example, a factor loading of 0.9 for the WIG stock index implies that the common factor explains 90 percent of the variance in Poland's stock prices. In other words, a substantial part of the factor-based FCI reflects developments in Poland's equity market, irrespective of whether stock prices matter for growth.



26. The factor-based FCI is also driven to a large extent by external factors (S&P 500 stock index, VIX index, and EURIBOR-OIS spread)**.** All the three external variables have factor loading of more than 80 percent. Higher S&P 500 index, low VIX and EURIBOR-OIS spread are associated with better financial conditions (higher FCI). On the domestic front, higher WIG index, easy lending standards, and REER appreciation pull up FCI,[13] while high WIBOR rate and corporate lending rate are associated with a more adverse financial environment.

D. Forecast Evaluation

27. We undertake demonstrative in-sample and out-of-sample forecasting exercises to evaluate the ability of the constructed FCIs in forecasting GDP growth and other macroeconomic variables. As an example, we compare FCI performance to that of the composite leading indicator developed by the OECD. The CLI takes into account not only financial developments but also economic activity variables such as manufacturing production and labor market tightness. Specifically, the following equation is estimated:

$$y_{t+h} = \alpha + \sum_{i=1}^{3} \beta_i y_{t+1-i} + \gamma X_t + \varepsilon_t,$$

[12] REER and the stock price indices enter as year-on-year growth.

[13] Since the FA model does not capture the relationship between financial variables and GDP, an appreciation of REER, mainly driven by an appreciation of domestic currency, corresponds to improving aggregate financial conditions.

where y_{t+h} denotes the h-quarter-ahead value of the forecast variable (year-on-year growth in GDP, industrial production, employment, and the unemployment rate), and X_t denotes the indicator being evaluated (FCI or CLI). The VAR-based FCI used in this exercise is the four-quarter moving average of the original index, so that it can be compared to year-on-year variables. The number of lags (i.e., 3) on the autoregressive part is chosen based on the Akaike Information Criteria.

28. The FCIs tend to perform better than CLI in in-sample predictive tests, as indicated by the higher F-statistics and partial R-squared. By adding FCIs, the forecasting power of the autoregressive part has been improved, and the forecasting power of FCIs is stronger than the CLI. The partial R-squared measures the marginal contribution of the index to explaining the forecast variable when lagged parts of growth are kept constant. For example, panel (a) in Table 2 implies that the errors in predicting two-quarter-ahead GDP growth based on its autoregressive parts could be reduced by 48 percent by adding the VAR-based FCI, and 42 percent by adding the factor-based FCI, as opposed to only 22 percent by adding CLI. Similar results hold for predicting industrial production, employment, and unemployment rate. While the VAR-based FCI performs well at the two-quarter forecast horizon, the factor-based FCI tends to dominate at the four-quarter horizon (panel (b) of Table 2). This is consistent with our remark earlier, that the factor-based FCI is constructed such that it captures only the exogenous financial developments that potentially affect future growth.

Table 2. In-Sample Predictive Tests

(a) h = 2

	F-stat				Partial R-squared		
Forecast variable	AR	VAR FCI	Factor FCI	CLI	VAR FCI	Factor FCI	CLI
Real GDP	7.7	**17.1**	14.5	9.1	**0.48**	0.42	0.22
Industrial production	10.9	**33.5**	24.9	11.6	**0.64**	0.54	0.21
Employment	18.4	19.1	**20.3**	16.4	0.23	**0.26**	0.13
Unemployment rate	36.5	**50.8**	42.6	40.7	**0.42**	0.33	0.30

(b) h = 4

	F-stat				Partial R-squared		
Forecast variable	AR	VAR FCI	Factor FCI	CLI	VAR FCI	Factor FCI	CLI
Real GDP	0.7	**7.0**	6.0	5.2	**0.49**	0.45	0.41
Industrial production	0.8	7.2	**7.9**	7.3	0.49	**0.52**	0.50
Employment	4.1	10.3	**23.5**	6.4	0.44	**0.69**	0.27
Unemployment rate	7.5	14.8	**17.6**	8.5	0.45	**0.51**	0.21

Note: h denotes forecast horizon in quarters.

29. The superior ability of FCI in forecasting near-term growth is also borne out by out-of-sample predictive tests. We examine the root mean squared errors (RMSE), obtained by estimating the model up until 2009Q4 and calculating the forecast errors over the sub-sample 2010Q1-2012Q4 (Table 3). The RMSE is measured relative to that from an autoregressive model, i.e. without either FCI or CLI. Thus, a number less than one indicates better out-of-sample forecasting performance compared to an autoregressive model. Table 3 shows that both the VAR-based and factor-based FCI performs better than the composite leading indicator and the autoregressive model in predicting two- and four-quarter-ahead GDP growth, while the autoregressive model remains superior for forecasting employment growth and the unemployment rate.

Table 3. Out-of-Sample Predictive Tests, Relative RMSE

	h=2			h=4		
Forecast variable	VAR FCI	Factor FCI	CLI	VAR FCI	Factor FCI	CLI
Real GDP	**0.88**	**0.88**	0.98	0.81	**0.72**	1.09
Industrial production	**0.94**	1.42	0.97	1.23	1.10	1.03
Employment	1.12	1.02	1.13	1.21	**0.58**	1.41
Unemployment rate	1.66	1.18	1.57	2.04	1.10	2.56

Note: RMSE relative to AR model, h denotes forecast horizon in quarters.

E. Conclusion

30. In this paper we construct a financial conditions index for Poland using two alternative models, namely VAR and FA. Decomposition of the VAR-based FCI into relative contributions of the individual financial indicators helps further our understanding of macro-financial linkages in Poland's economy. In particular, the WIBOR rate, lending standards, and the corporate loan spread play major roles in driving aggregate financial conditions due to their strong co-movement with the business cycle. External indicators capturing the degree of financial stress globally and in the euro area also prove important. The FCI can be usefully employed as an analytical tool to inform monetary policy analysis as well as near-term growth forecasting. A caveat to keep in mind is that the FCI is conditioned on the static historical relationship between real and financial variables; therefore, if this relationship has changed, the model would need to be reassessed.

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AN ASSESSMENT OF PUBLIC EXPENDITURE RULES FOR POLAND[1]

This note presents the simulations of four public expenditure rules calibrated for Poland and discusses their adequacy to help anchor public finances. Two of the variants tend to dominate in terms of their long-term dynamics and their robustness to a variety of plausible macroeconomic scenarios. In contrast, the other variants tend to generate excessive fiscal adjustment due to a tightening bias imbedded in the formulas. The results also point to the usefulness of incorporating the medium-term objective (MTO) directly in the mechanism.

A. Introduction

1. In recent years, Poland has achieved substantial fiscal consolidation. Measures to contain the fiscal deficit in the aftermath of the global financial crisis led to a reduction in the headline deficit from 7.9 percent of GDP in 2010 to 3.9 percent in 2012. Despite this improvement, fiscal buffers are thin, as public debt stands close to important legal limits established by the Polish Constitution and Public Finance Law.[2]

2. To help achieve long-term fiscal sustainability, the authorities plan to strengthen the fiscal framework. The authorities have established a medium-term objective (MTO) of a fiscal deficit of 1 percent of GDP in structural terms, which staff considers adequate to preserve fiscal sustainability and put the public debt ratio on a firm downward path. A stronger fiscal framework would provide support to achieve the MTO over time, help limit spending bias (Hauptmeier, Sanchez, and Schuknecht, 2010; Wierts, 2008) and ameliorate procyclicality in fiscal policy (Ilzetzki and Vegh, 2008).

3. In this context, the authorities plan to implement a permanent fiscal rule. This would complement existing public debt limits, which have proven useful but insufficient in the past

[1] Prepared by Francisco Vázquez. An early version of the codes used in the simulations was written by Giang Ho (SPR), and subsequent versions were developed jointly with Karolina Konopczak, Dominik Korniluk, Kamil Łuczkowski and Mateusz Wolski (all MoF). The author wants to thank, without implicating, the open and constructive exchanges with the authorities, in particular with Mesrs. Sławomir Dudek, and Tomasz Szałwiński, and Dominik Korniluk (all MoF). The note benefited from discussions with, and suggestions from, Robert Sierhej (ResRep Office), Julie Kozack and Yinqiu Lu (EUR), Richard Hughes, Joana Pereira, Dimitri Radev, and Andrea Schaechter (all FAD), and Carlos Cáceres (MCM).

[2] The Constitution caps public debt (based on a national definition) at 60 percent of GDP. In addition, the Public Finance Law establishes two preventive debt thresholds at 50 and 55 percent of GDP. The public deficit is subject to increasing restrictions when public debt to GDP (after adjustments for the exchange rate and liquid holdings of the Ministry of Finance) exceeds these thresholds. The national definition of debt has narrower coverage than ESA95, as it excludes the liabilities of the National Road Fund, and some other entities.

(Rutkowski, 2007). Regarding mechanism design, the authorities have expressed their preference for a simple expenditure rule, on grounds of transparency, predictability and ease of implementation across budgetary units (Anderson and Minarik, 2006; Schaechter *et al*. 2012). They have also favored the use of actual (instead of projected) data in the formulas. Going beyond these preferences, and from a normative standpoint, the rule should behave in a smooth countercyclical fashion under normal conditions, and produce a stable and predictable path of public expenditures, consistent with the MTO. Also, the rule should deliver robust results under various macroeconomic scenarios and provide adequate flexibility for countercyclical fiscal policy under adverse circumstances.

4. The rules presented in this note follow the authorities' preferences. They explicitly avoid the use of relatively complex techniques (i.e., the Hodrick-Prescott filter) or non-observable economic concepts (i.e., potential GDP). The formulas also refer to macroeconomic data available at the time to the budget preparation. Arguably, this backward-looking formulation may enhance transparency and credibility, but at the cost of precision if macroeconomic prospects depart from the immediate past.

5. The rules are assessed in terms of their cyclical and long-term properties. The analysis is based on Monte Carlo simulations covering a wide range of plausible macroeconomic scenarios, projected over 37 years (i.e., until 2050). The proposed metrics to assess the rules gauge their capacity to generate a stable and predictable restraint on public expenditures consistent with long-term fiscal solvency. The assessment takes into account the simplicity of the rules, possible interference with fiscal policy, induced fiscal procyclicality, and flexibility to deal with adverse economic shocks.

6. Three of the proposed mechanisms seem to have an embedded fiscal tightening bias. They share a basic structure that limits expenditure growth to be at, or below, trend GDP growth. The simulations illustrate a fiscal-tightening bias associated with this formulation: when the correction becomes binding and reduces the growth of public expenditures, it also lowers the expenditure base for subsequent periods (regardless of fiscal performance and the state of the economy). This tends to introduce a one-way bias in the ratio of public expenditures to GDP that would generate protracted fiscal surpluses, unless compensated by successive tax policy cuts.

7. An alternative to deal with this bias is to augment the expenditure rule with a notional account and a correction mechanism. A notional account would accumulate deviations between the fiscal balances and the MTO, and a symmetric correction mechanism would force higher growth of public expenditures if fiscal surpluses accumulate. However, this may come at the expense of further complexity, with associated costs in terms of transparency and governance. This also leads to unwarranted fiscal rigidity as the correction would tend to bind more frequently (i.e., it will do so to cap the growth of expenditures, but also to correct the fiscal tightening bias). Also, a symmetric correction mechanism would at times force an expansion of public expenditures, which stands at odds with the notion of an expenditure ceiling.

8. In turn, an expenditure rule akin to the Swiss debt brake seems to have a number of useful characteristics, but careful calibration is needed to avoid excessive procyclicality and large expenditure cuts on impact. The proposed formula combines information on the ratio of public revenues to GDP with the MTO and a measure of trend growth as a proxy for potential GDP growth. Thus, the formula departs from the Swiss debt brake, which uses the output gap (measured via the HP-filter), to adjust for the cycle (Geier, 2004, 2011). The results also show that fine-tuning of the Swiss debt rule, geared toward smoothing the path of expenditures, may be necessary to reduce its cyclicality.

9. The rest of the note is as follows. Section B presents a description of the proposed rules within the common framework of a balanced budget mechanism. Section C describes the set of indicators used to assess the properties of the rules. Section D discusses the methodology and assumptions used in the simulations. Section E presents the main results, and section F concludes.

B. Varieties of Expenditure Rules

10. This section provides a description of the expenditure rules analyzed in this note. To establish a general context, consider the augmented growth-based rule:

$$b_t = b^* + c(b_{t-1} - b^*) + a(g_t - g^*), where\ a > 0, and\ 0 < c < 1 \qquad [1]$$

Or, rearranging:

$$b_t = cb_{t-1} + (1-c)b^* + a(g_t - g^*)$$

In this expression, the sub-indexes stand for the time dimension. The variables are as follows. The budget balance floor in period *t* is denoted by b_t, while b^* stands for the MTO (both expressed in percent of GDP). Real GDP growth is denoted by g_t, and g^* is an indicator of trend growth. Both b^* and g^* would in general vary over time, but the subscripts are omitted to save notation. In terms of timing, the budget of year *t* is prepared and approved in *t-1*, with historic data available up to *t-2*. Thus, under this rule, the budget balance in time *t* is a weighted average between the budget balance in the previous period and the MTO, with the weights defined by the smoothing parameter *c*. A lower value of *c* puts higher weight on the MTO. In addition, the rule requires a higher balance when GDP growth is above its trend, to convey a countercyclical dynamics.

11. Equation [1] can be rearranged as an expenditure rule. Under the extreme assumption that nominal government revenues R_t are a stable fraction β of GDP, Y_t, (i.e., $\beta = R_t/Y_t$), this rule becomes:

$$\bar{e}_t = ce_{t-1} + (1-c)(\beta - b^*) - a(g_t - g^*) \qquad [2]$$

where $\bar{e}_t$ stands for the public expenditure ceiling (in percent of GDP) at time *t*. According to this rule, the expenditure ceiling at time *t* is a weighted average of the expenditure in the previous period and the expenditure consistent with the MTO, augmented by a cyclical adjustment.

During the upward phase of the economic cycle expenditures are subject to a downward adjustment that depends on the parameter a. In the steady state, $e_t=e_{t-1}$ and the third term collapses to zero and the fiscal balance equals the MTO: $\beta-e= b^*$.

12. In turn, expression [2] can be expressed in terms of the nominal expenditure ceiling using $E_t=e_tY_t$:

$$\bar{E}_t = c(1+\pi_t)(1+g_t)E_{t-1} + (1-c)(\beta - b^*)Y_t - a(g_t - g^*)Y_t \qquad [3]$$

where π_t stands for the GDP deflator. Thus, the first two terms force the expenditure ceiling in period t to fall between the expenditures observed in the previous period (augmented by the nominal rate of GDP growth), and the level of expenditures consistent with the MTO (given by the second term). The third term introduces the counter cyclical dynamics. In this expression, it is possible to account for changes in tax policy, ΔT_t, by adding this term to the right-hand side, as in some countries (Gosta, 2008).

13. Three of the mechanisms under analysis share a basic structure. They limit the growth of public expenditures using restricted versions of expression [3]. In general, when the corrections do not bind, expenditures are restricted to growth with trend GDP. On the other hand, when the corrections bind and require fiscal consolidation, expenditures are set to grow below trend GDP growth. The triggers for fiscal consolidation vary across the three mechanisms. They entail a combination of debt to GDP ratios, the size of previous fiscal deficits, and the presence of an excessive deficit procedure (EDP). To reduce pro-cyclicality, the proposed rules allow for a suspension of the mechanism during an economic downturn, which is defined as a projected real GDP growth rate 2 percentage points below the medium-term rate. The specific features of each rule are as follows.

Variant 1. Multiplicative Correction to the Growth Rate (Multiplicative)

14. The first variant limits the growth of public expenditures in a multiplicative fashion:

$$\bar{E}_t = [1 + (\pi_t + g_t^* + \pi_t g_t^*)m_t]E_{t-1} \qquad [4]$$

where m_t is a multiplicative correction that equals: (i) 0.7 if an EDP is in place or if debt-to-GDP exceeds 55 percent; and (ii) 0.8 if debt-to-GDP is between 40 and 55 percent. The calculation of trend GDP growth g_t^* is based on the geometric mean between *t-7* and *t*. Thus, the formula combines observed realizations of GDP growth with forecasted values for years *t-1* (the budget period) and *t* (the projected period). The formula in [4] is a special case the augmented growth-based rule [3], were the cyclical adjustment parameter a=0 and the smoothing parameter c=1. These two departures are material. First, dropping the countercyclical adjustment would affect the short-term dynamics of the rule in a potentially undesirable way. Second, by placing all the weight on the previous level of expenditures, this proposal drops the reference to the MTO in the main equation. In turn, adjustments for past errors in forecasted inflation, GDP growth, or budget execution, are not taken into account, presumably as a way to simplify the mechanism.

Variant 2. Additive Correction to the Growth Rate with Symmetric Correction (ACGS)

15. The second variant uses an additive correction to the growth rate of real public expenditures:

$$\bar{E}_t = (1 + \alpha_t \pi_t)(1 + g_t^* - n_t)E_{t-1} \quad [5]$$

where the parameter α_t is an adjustment to the inflation forecast that compensates for forecast errors in the previous budget. As before, g_t^* is an indicator of trend GDP growth, computed by the geometric mean of real GDP growth over eight periods. The term n_t is an additive correction factor that modifies the growth of real expenditures if fiscal adjustment is deemed necessary (the correction triggers are described below). The rule described in [5] is complemented with a notional account, k_t, which accumulates deviations between the actual general government balances and the MTO:

$$k_{t+1} = k_t + (b_t - b^*) \quad [6]$$

16. This notional account plays a key role in the adjustment process. It tracks the cumulated deviations between the fiscal balance and the MTO, and provides the basis for a *symmetric* correction mechanism. In particular, the parameter n_t would take the following values: (i) 2 percentage points if the Excessive Deficit Procedure is in place or if debt-to-GDP is above 55 percent; (ii) 1.5 percentage points if the notional account drops below −6 percent of GDP (this correction would remain in place until the cumulated deviations registered in the notional account rise above −3 percent of GDP); (iii) −1.5 percentage points if the notional account grows above +6 percent of GDP; (iv) zero otherwise. As before, equation [5] stands as a special case of [3], with a=0 and c=1.

17. Under this formulation, the notional account provides an indirect link to the MTO. While the MTO is excluded from the main equation, it would still play an indirect role through the notional account. This link, however, would operate only if (and when) the correction is triggered due to the notional account. Is it worth noting that, in the asymmetric correction case, equation [6] would fail to limit the long-term dynamics of the notional account. In the steady state, if the budget balance converges to the MTO the second term would drop to zero, and the notional account would become undetermined. In other words, a sustainable fiscal policy would be consistent with any level of the notional account.

Variant 3. Additive Correction to the Level of Public Expenditures (ACL)

The third variant establishes an additive correction to the expenditure limit:

$$\bar{E}_t = [1 + (\pi_t + g_t^* + \pi_t g_t^*)]E_{t-1} - l_t Y_t \quad [7]$$

where l_t stands for an additive correction to public expenditures (in percent of GDP) equal to: (i) 1 percent if an EDP is in place or if debt-to-GDP exceeds 55 percent; (ii) 0.5 percent if debt-to-GDP is between 40−55 percent and the average nominal balance during the last 4 consecutive

years below the MTO minus 2 percentage points; (iii) 0.1 percent if debt-to-GDP is between 40−55 percent and the average nominal balance during the last 4 consecutive years above the MTO minus 0.5 percentage points (negative deviations between 0.5−2.0 percentage points below the MTO are acceptable, provided they diminish gradually, year by year, toward null during the transition period).

18. These three variants impose a restriction to the growth of public expenditure, using their lagged value as a base. This feature would tend to generate a downward bias in the adjustment process and unwarranted long-run dynamics. For example, in response to an adverse economic environment, the budget balance would deteriorate triggering a cut in expenditures via the workings of the rule. If the adjustment lowers the share of expenditures to GDP, the rule will prevent a subsequent reversion (due to base effects), generating fiscal surpluses over protracted periods. This problem would tend to be more acute if trend GDP growth is stable or increasing over time.

Variant 4. A Modified Swiss Brake (MSB)

19. The analysis also considers a backward-looking variant of the Swiss debt brake rule, given by:

$$\bar{E}_{t+1} = c(1+\pi_{t+1})(1+g^*_{t+1})\bar{E}_t + (1-c)(\frac{R_{t-1}}{Y_{t-1}} - b^*)Y^*_{t+1} - C_{t-1}\,, \qquad \text{with } 0<c<1 \qquad [8]$$

$$C_t = \alpha(K_{t-1} + E_t - E^*_t) \qquad [9]$$

In this expression, expenditures in t+1 are a weighted average of expenditures in the previous year adjusted by trend growth, and the level of expenditures compatible with the MTO, given by the second term. This term is the main difference with the previous expenditure rules: it guides expenditures toward the MTO and "resets" the basis of expenditures according to the evolution of revenues (as of t−1). The use of lagged values of revenues and GDP, which are known at the time of budget preparation, is intended to improve transparency and reduce reduce moral hazard problems. In turn, $Y_{t+1}{}^*$ stands for trend GDP, used as a proxy for potential. The term C_t is a correction for past deviations between the actual execution of expenditures, E_t, and the (ex-post) expenditures consistent with the rule, $E_t{}^*$, computed with actual realizations of revenue collections and economic activity (Bodmer, 2006). The parameter $0<\alpha<1$ governs the distribution of these deviations between the corrections and a notional account[3]:

$$K_t = (1-\alpha)(K_{t-1} + E_t - E^*_t) \qquad [10]$$

[3] In the simulations, the smoothing parameter c was set to 0.5, implying that expenditures are required to be half way between and the previous budget and the level consistent with the MTO. In turn, the speed to the correction parameter alpha was set to 0.2, implying that the corrections are distributed over five years.

Thus, the notional account collects two types of errors: (i) forecast errors in the projection of nominal GDP (both headline and potential) and in government revenues; (ii) deviations between budgeted expenditures and their actual execution. The rule differentiates between ex-ante and ex-post performance, and incorporates corrections for forecast errors and budget execution. Under the assumption that economic forecasts and performance in the budget execution are unbiased, errors in the notional account would tend to cancel over time, reducing the size of the corrections. This is a fundamental difference from the notional account [6], as the latter is needed to correct the fiscal tightening bias in the main formula.

A Benchmark:

20. To help gauge the behavior of the four variants, the simulations include a rule that assumes perfect foresight of the output GAP, and the realization of revenues and output:

$$\bar{E}_t = \frac{R_t}{(1+GAP_t)} - b^* Y_t \qquad [11]$$

Where GAP_t stands for the output gap at time t.

C. Methodology

A Set of Metrics to Assess the Expenditure Rules

21. The cyclical and long-term properties of the alternative expenditure rules were assessed using several metrics (Table 2).

- The cyclical behavior of general government expenditures under each rule was measured by the correlation between the output gap (proxied by the distance between actual and trend output), and the cyclical component of expenditures. These correlations were computed over the entire projection period, including economic downturns. Ideally, the rules should not induce procyclicality in the fiscal deficit, allowing instead a role for automatic stabilizers, particularly during the downturn or in the face of a crisis situation. In particular, the correlations were given by:

$$\mathrm{Corr}(\mathrm{GAP}, \text{cyclical expenditures}) = \mathrm{Corr}(\mathrm{GAP}, \frac{\bar{\mathrm{E}}_t - \bar{\mathrm{E}}_{t-1}(1+g^*)}{\bar{\mathrm{E}}_{t-1}}) \qquad [12]$$

- The severity of the expenditure cuts generated by the rules, notably their short-term behavior, were also assessed by computing the largest cumulative cut in the share of expenditures to GDP over 1 to 3 year horizons.

- In turn, the long-run behavior of the rules was assessed with the help of several descriptive indicators, including: (i) the maximum and minimum debt-to-GDP ratios; (ii) the debt-to-GDP ratio at the end of the projection period; (iii) the maximum and minimum levels of the notional account (where applicable); (iv) the number of years where the corrections were binding; (v) and the number of years were an EDP was in place.

Numerical Simulations

22. The behavior of expenditures under each of the four rules was modeled with the help of Monte Carlo simulations. The exercises were conducted by projecting the relevant series (i.e., GDP growth, fiscal revenues and expenditures, and inflation) over a 37-year horizon (until 2050). Each exercise entailed 500 simulations. Initial values of the relevant variables were set to their actual levels in 2012 (the latest available). In all the simulations, revenue collections, the output gap, and prices were modeled as stochastic processes, and their association was calibrated using historic information over 1995–2012. In turn, the data generating processes were allowed to follow three different sets of assumptions regarding potential GDP growth in the long-term. These encompassed: a set of baseline scenarios that exploited historic information of the series as the basis of the projections, plus two sets of forward-looking scenarios based on long-term official projections from the MoF and the Aging Working Group (AWG). The latter incorporated unfavorable demographic trends and thus entailed a downward trend in potential GDP.

23. The scenarios also included a severe but plausible shock to GDP growth. To analyze the behavior of the rules under adverse circumstances, each set of scenarios was also modeled by imposing a shock to GDP growth equal to −3 standard deviations in 2020 and −2 standard deviations in 2021.

D. Results

24. The macroeconomic scenarios encompassed a wide range of plausible paths of GDP growth. The evolution of average GDP growth under each set of scenarios illustrates the differences in the underlying assumptions (Figure 1). The baseline scenarios imply an average trend growth of about 3½ percent per year, which is more optimistic than the MoF and the AWG scenarios. In the latter, trend GDP drops 1¾ percent per year at the end of the projections. The simulations covered a wide range of plausible paths for GDP growth, as illustrated by the range between the 10^{th} and the 90^{th} percentiles of the distributions (Figure 2).

25. The evolution of average public expenditures illustrated the pros and cons of varius alternatives. (Figures 3–6).

- Variant 1 (Multiplicative). The Multiplicative rule tends to impose a downward bias to public expenditures, as illustrated by the sharp drop in average debt-to-GDP ratios under the baseline scenarios. This feature is somewhat ameliorated in the MoF and the AWG scenarios, due to the declining growth path. On the positive side, the rule generated a low correlation with the business cycle and produced a smooth drop in expenditures at the 1–3 year horizons.

- Variant 2 (ACGS). In the baseline scenarios, the Additive Correction to the Growth of expenditures (Symmetric case) helped stabilized average the ratio of public expenditures to GDP at around 38 percent in the long run, and delivered an average balance consistent with

the MTO. On impact, expenditures undershoot their long-term equilibrium, which suggests the need for a phased implementation. The results, however, were noticeably less stable under the MoF and AWG scenarios, indicating some lack of robustness to a plausible set of macroeconomic conditions.

- Variant 3 (ACL). The Additive Correction to the Level of expenditures displayed a number of clearly undesirable dynamics. On impact, it resulted in rapid and substantial reduction in public expenditures, leading to sizable and recurrent fiscal surpluses. As a result, debt-to-GDP dropped monotonically to negative territory. Furthermore, in the initial years, average public expenditures to GDP undershoot their long-term level, which provides additional evidence of excessive fiscal adjustment. These results were somewhat less pronounced (but not eliminated), in the MoF and the AWG scenarios, as the declining trend potential GDP growth and ensuing effects on revenues helped counteract the workings of the rule.

- Variant 4 (MSB). The behavior of the Modified Swiss Brake was qualitatively similar to the ACGS in the Baseline scenarios, but somewhat more stable and closer to the benchmark rule in the MoF and the AWG scenarios. The deficit stabilized around the MTO leading to an asymptotic convergence of debt-to-GDP to 20 percent in the Baseline scenarios and 25−30 percent in the MoF and AWG scenarios. However, the simulations produced some overshooting of fiscal consolidation on impact, suggesting that a phased implementation period would be necessary. Overall, the standard deviations of most metrics were generally lower under the MSB, and the mechanism appeared adequate to contain debt below 60 percent. On the negative side, the MSB produced a more aggressive reduction of public expenditures on impact (using a smoothing parameter c=0.5). The correlation of expenditures with the output gap was also larger than for the other mechanisms, albeit substantially lower than 1 and comparable to the Benchmark mechanism. In the distressed scenarios, the MSB allowed a widening of the deficit on impact and appeared less restrictive than the other variants in the aftermath of the shock.

26. Summary statistics of the metrics provide further substantiation to these findings (Tables 3−6). In these tables, the upper panels show the average values of the metrics computed across the 500 paths simulated for each scenario, and the middle panels show the corresponding standard deviations and the lower panels the ranges between the 10^{th} and 90^{th} percentiles of the distributions. Consistent with the previous discussion, the Multiplicative and the ACL rules tended to generate excessive fiscal adjustment under the baseline scenarios. As a result, minimum debt-to-GDP ratios reached negative values during and at the end of the projections. This shortcoming was noticeably worse in the case of the ACL.

27. The MSB mechanism was somewhat more robust than the ACGS under alternative macroeconomic environments. In the Baseline scenarios, both the MSB and the ACGS generated a reasonable average drop in debt-to-GDP ratios. At the same time, the standard deviations of debt-to-GDP ratios were somewhat lower under the MSB (translating into a narrower distance between the 10−90 percentiles of the distribution). Worryingly, both the MSB and the ACGS generated negative values of debt-to-GDP in a subset of the simulations (as

indicated by the ranges of minimum and final debt-to-GDP). In the case of the ACGS, this problem was more pronounced under the MoF and the AWG scenarios. Thus, the excess constraints on expenditure imposed by the ACGS escalated under weaker long-term economic growth, which is clearly undesirable. It is worth noting that the ranges of the minimum, maximum, and final debt-to-GDP ratios were less stable under the ACGS across the three scenarios, with several instances where debt-to-GDP crossed above the 55 percent threshold. In contrast, the ACGS rule performed better at the short-term horizon. In addition ACGS was less severe on impact and within 1−3 years, and also less procyclical than the MSB.

E. Concluding Remarks

28. The simulations presented in this note suggest that there are no "silver bullets". None of the rules displays strict dominance across all the different metrics. At the same time, the results offer insight on the relative advantages and weaknesses of each mechanism.

29. Two of the mechanisms may require a notional account with a symmetric correction. Both the multiplicative and the additive expenditure rules with asymmetric corrections imposed a downward bias in expenditures, and result in excessive (and likely unfeasible) fiscal consolidation.

30. More generally, the results illustrate the advantages of including the MTO in the main formula of the fiscal rule. Expenditures under the ACGS are linked to the MTO, albeit in an indirect way, through the workings of a notional account. As the simulations show, this may create some problems. First, as times goes, the cap on expenditures becomes disconnected from the fiscal balance until the correction mechanism is triggered, which creates room for excessive fiscal consolidation, as the correction mechanism allows cumulative deviations from the MTO within a band of −/+6 percent of GDP. From the mechanical point of view, the dependence of expenditures on its previous level creates a base effect that tends to lock-in low expenditures. Second, a link to the MTO through a notional account may lead to some delays in the corrections. This tends to amplify swings in public expenditures and debt and ultimately reduces the robustness of the mechanism under plausible macroeconomic circumstances.

31. A drawback of the ACGS seems related to the number and complexity of corrections, and their frequent activation. Since the ACGS lacks a reference to the MTO in the main formula, a number of (symmetric) corrections are needed to counteract the tightening bias embedded in the mechanism. Furthermore, the symmetric nature of the corrections force an expansion of expenditures under certain circumstances (i.e., to curb the increase of the notional account following a period of excessive fiscal consolidation).

32. In turn, the MSB tends to generate sharp cuts in expenditures, and the addition of a smoothing term complicates the formula. The MSB tends to generate excessive expenditure cuts at the one-year horizon, and pro-cyclical behavior similar to the benchmark perfect-foresight mechanism. At the same time, the pro-cyclicality of the MSB is lower during the downturn of the economic cycle, which is appropriate. Despite lack of normative guidance on this issue, further analysis on the short-term behavior of the MSB may help fine tune the formula parameters to smooth the adjustment process. Unfortunately, the addition of a smoothing term to deal with this issue (i.e., the first term of equation [8]) tends to complicate the formula.

33. In all, the ACGS and the MSB tend to dominate, but further revisions may be needed. The ACGS tends to deliver a smoother behavior of expenditures but it appears less robust to alternative macroeconomic scenarios. There may be room to simplify the mechanism by delinking the adjustments from legal debt thresholds and from the EDP. By comparison, the MSB tends to be more pro-cyclical and induce sharper expenditure cuts, but is also appears more robust to a variety of macroeconomic scenarios. It is worth noting that the short-term behavior of the MSB analyzed in this note may be partly attributable to its backward-looking nature (i.e., the mechanism refers to past fiscal revenues and nominal GDP instead of expected values). While this is intended to avoid moral hazard problems associated with the manipulation of forecasted series, it may increase the volatility of government expenditures. In this regard, it may be worth considering a forward-looking formula to analyze further this issue, since any gaps between projected and realized series would be accounted for the correction mechanism over time.

Figure 1. Evolution of Average Real GDP Growth Under Various Scenarios

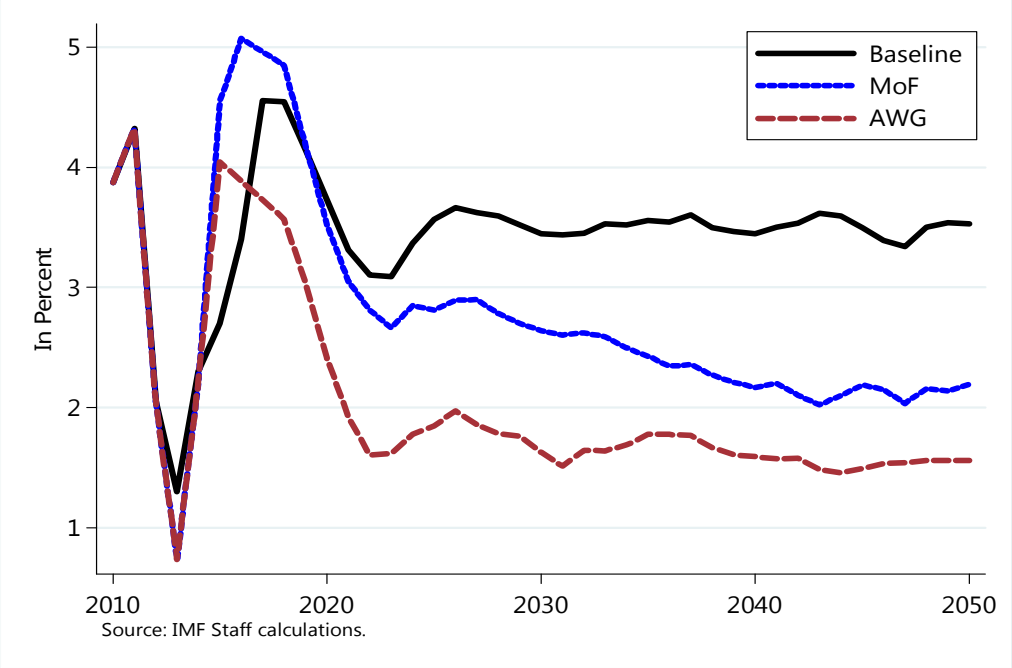


Figure 2. Evolution of Distributions of Real GDP Growth Under Various Scenarios

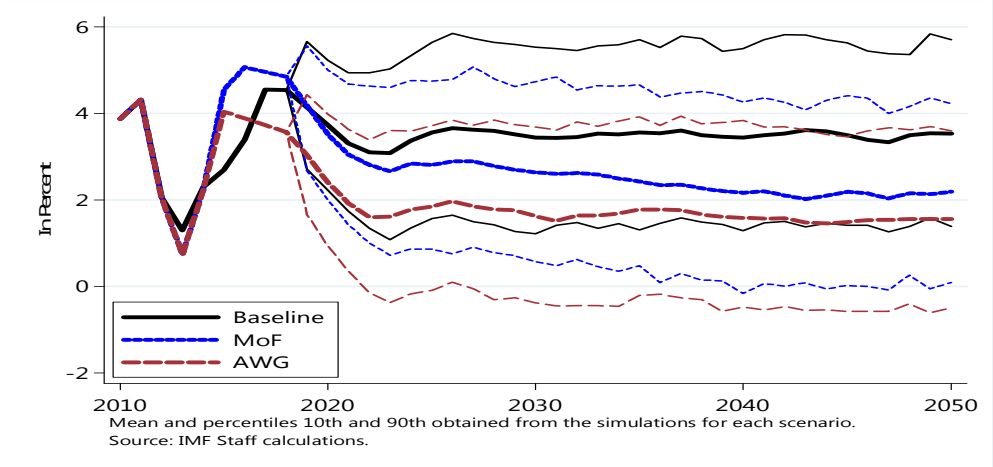
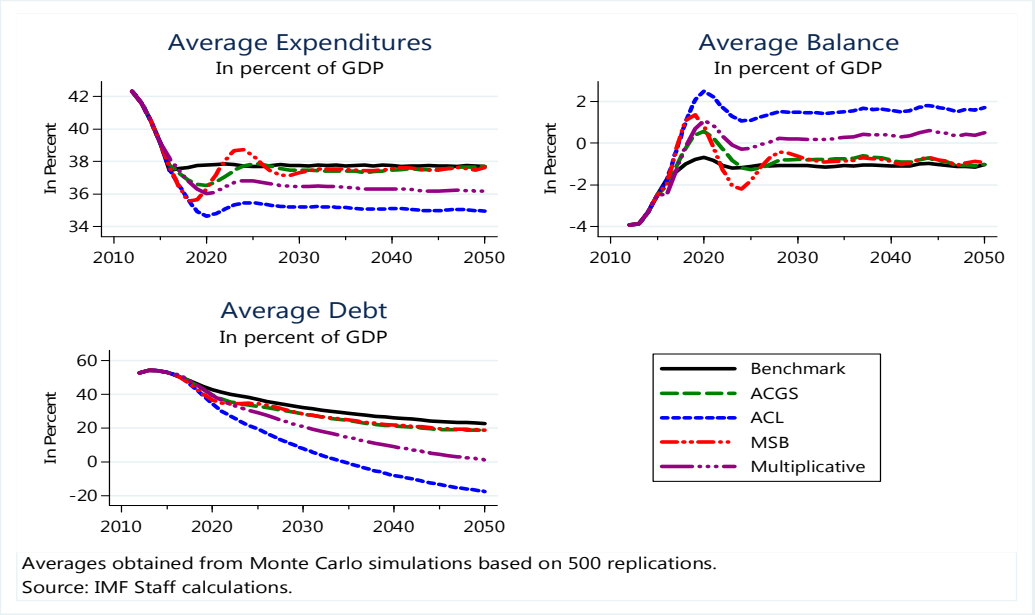
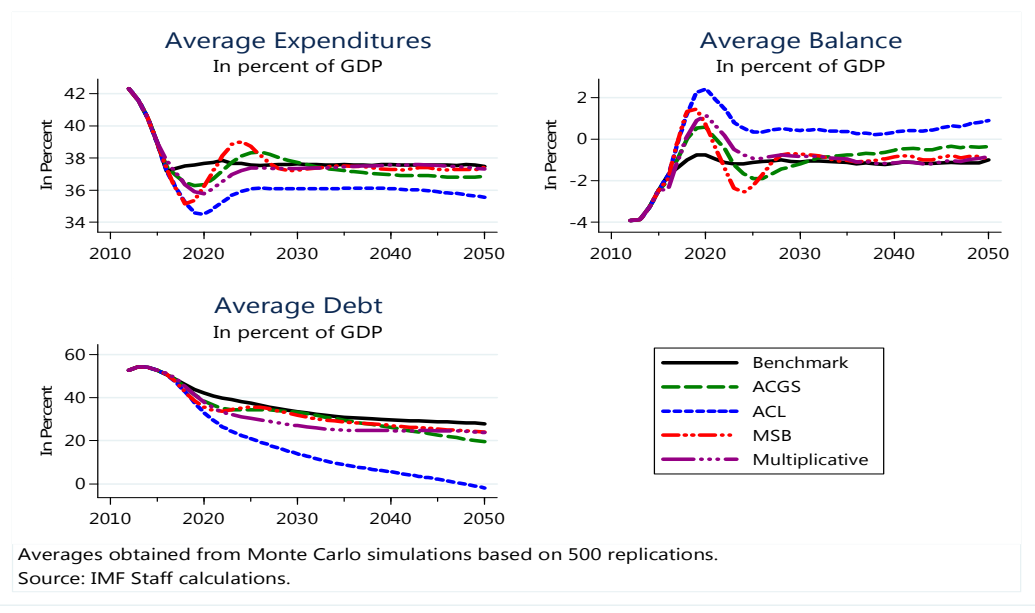


Figure 3. Evolution of Selected Variables Under the Baseline Scenarios



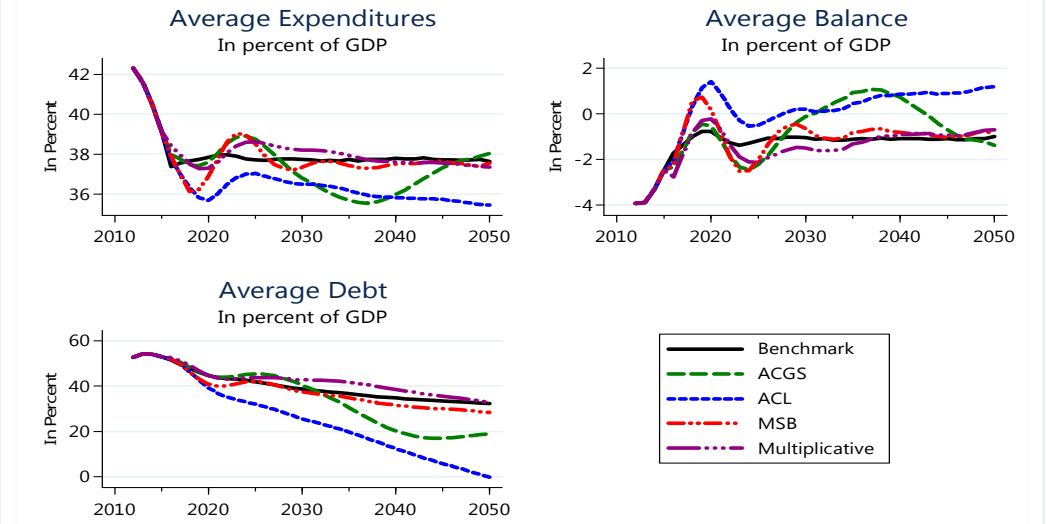
Averages obtained from Monte Carlo simulations based on 500 replications.
Source: IMF Staff calculations.

Figure 4. Evolution of Selected Variables Under the MoF Scenarios



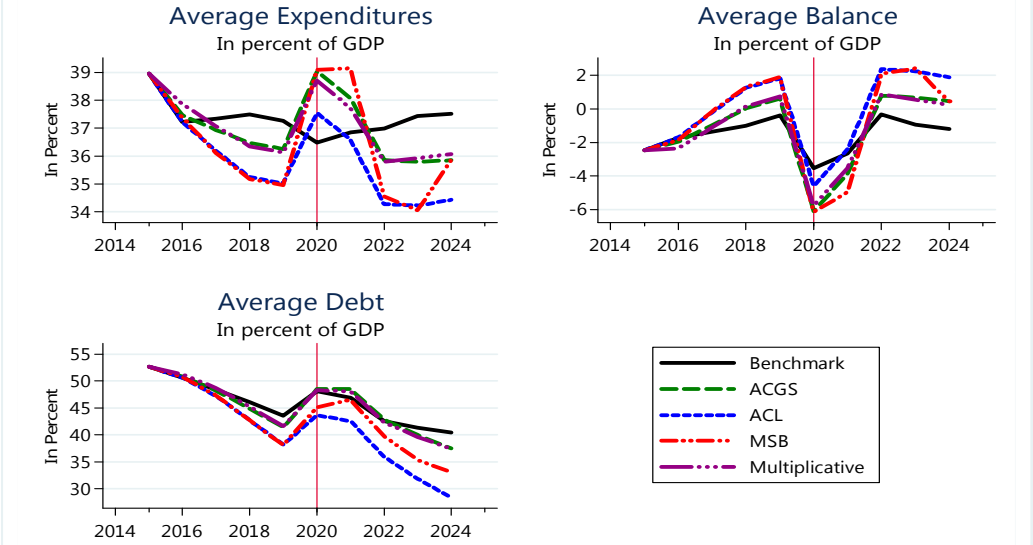
Averages obtained from Monte Carlo simulations based on 500 replications.
Source: IMF Staff calculations.

Figure 5. Evolution of Selected Variables Under the AWG Scenarios



Averages obtained from Monte Carlo simulations based on 500 replications.
Source: IMF Staff calculations.

Figure 6. Evolution of Selected Variables Under the MoF Shocked Scenarios



Averages obtained from Monte Carlo simulations based on 500 replications.
Source: IMF Staff calculations.

Table 1. Triggers of Corrections

	EDP	Debt to GDP	MTO	Past Average Balances
ACGS	yes	yes	indirect (through noc. acc.)	
Multiplicative	yes	yes		yes
ACL	yes	yes		yes
MSB			direct (in main formula)	
Escape Clause	Projected GDP growth 2-3 percentage points below trend.			

Sources: National authorities and IMF staff.

Table 2. Metrics for the Assessment of the Rules

Property:	Metric:
Cyclical behavior	Correlation Output Gap and Expenditure Policy Gap
	Correlation Output Gap and Expenditure Policy Gap in Downturns
	Largest cummulative drop in GG expenditures over one year
	Largest cummulative drop in GG expenditures over two years
	Largest cummulative drop in GG expenditures over three years
Long-term behavior	Minimum Debt to GDP
	Final Debt to GDP
	Maximum Debt to GDP
	Maximum Notional Account
	Minimum Notional Account
	Number of Years that Debt is Above 40%
	Number of Years that Debt is Above 55%
Interference with fiscal policy	Number of Years that the EDP is in place
	Number of Years the rule is binding (triggers a correction)

Source: IMF staff.

Table 3. Summary Statistics of Metrics Under the Baseline Scenarios

	Type of Fiscal Rule				
	Benchmark	Multiplicative	ACGS	ACL	MSB
Averages over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	23.7	8.9	10.2	15.1	31.1
Correlation Expenditure Policy Gap-Output Gap in Downturns	19.7	-1.0	7.4	0.3	16.1
Minimum Debt to GDP	21.0	-1.3	11.0	-19.5	12.4
Final Debt to GDP	22.6	1.2	18.7	-17.5	18.7
Maximum Debt to GDP	51.1	51.9	51.5	51.2	51.3
Largest cummulative drop in GG expenditures over one year	-2.5	-1.3	-1.8	-1.8	-3.0
Largest cummulative drop in GG expenditures over two years	-2.6	-2.2	-3.2	-2.8	-5.2
Largest cummulative drop in GG expenditures over three years	-2.6	-2.9	-4.1	-3.7	-6.4
Maximum Notional Account	.	35.8	17.6	.	5.0
Minimum Notional Account	.	-8.9	-6.5	.	-6.4
Number of Years that Debt is Above 40 percent	9.2	6.8	7.8	5.4	6.4
Number of Years that Debt is Above 55 percent	0.0	0.0	0.0	0.0	0.0
Number of Years that the EDP is in place	0.7	1.9	6.2	0.4	7.3
Number of Years the rule is binding (triggers a correction)	0.2	7.0	17.3	5.6	7.0
St. Dev. over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	10.7	16.4	20.9	11.0	17.7
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.8	23.3	28.6	17.7	26.7
Minimum Debt to GDP	3.1	6.5	7.0	9.3	5.6
Final Debt to GDP	3.6	7.6	9.3	10.2	5.9
Maximum Debt to GDP	0.0	0.6	0.7	0.6	0.6
Largest cummulative drop in GG expenditures over one year	0.9	0.3	0.3	0.3	0.7
Largest cummulative drop in GG expenditures over two years	0.9	0.6	0.7	0.6	1.3
Largest cummulative drop in GG expenditures over three years	0.8	0.7	0.9	0.6	1.7
Maximum Notional Account	.	11.1	7.7	.	1.3
Minimum Notional Account	.	1.4	4.7	.	2.7
Number of Years that Debt is Above 40 percent	2.3	1.4	2.0	0.7	1.4
Number of Years that Debt is Above 55 percent	0.0	0.0	0.1	0.0	0.0
Number of Years that the EDP is in place	1.1	1.4	1.8	0.8	2.1
Number of Years the rule is binding (triggers a correction)	0.6	1.6	4.5	1.0	2.0
Average Ranges					
Correlation Expenditure Policy Gap-Output Gap	[-7; 56]	[-37; 55]	[-50; 90]	[-31; 61]	[-21; 74]
Correlation Expenditure Policy Gap-Output Gap in Downturns	[-76; 74]	[-74; 70]	[-68; 79]	[-43; 87]	[-50; 82]
Minimum Debt to GDP	[11; 32]	[-26; 20]	[-17; 26]	[-59; 3]	[-15; 22]
Final Debt to GDP	[13; 42]	[-24; 21]	[-17; 45]	[-59; 7]	[-4; 33]
Maximum Debt to GDP	[51; 51]	[51; 53]	[50; 62]	[50; 52]	[50; 53]
Largest cummulative drop in GG expenditures over one year	[-7; -1]	[-2; -1]	[-3; -1]	[-3; -1]	[-5; -1]
Largest cummulative drop in GG expenditures over two years	[-7; -1]	[-4; -2]	[-5; -2]	[-5; -2]	[-10; -3]
Largest cummulative drop in GG expenditures over three years	[-7; -1]	[-6; -2]	[-7; -2]	[-7; -3]	[-13; -3]
Maximum Notional Account	.	[1; 74]	[2; 54]	.	[2; 9]
Minimum Notional Account	.	[-18; -7]	[-36; 0]	.	[-19; -2]
Number of Years that Debt is Above 40 percent	[6; 20]	[5; 13]	[5; 15]	[5; 9]	[5; 11]
Number of Years that Debt is Above 55 percent	[0; 0]	[0; 0]	[0; 3]	[0; 0]	[0; 0]
Number of Years that the EDP is in place	[0; 8]	[0; 7]	[0; 12]	[0; 3]	[2; 13]
Number of Years the rule is binding (triggers a correction)	[0; 5]	[4; 13]	[1; 27]	[4; 9]	[2; 12]

Source: IMF Staff calculations.

Table 4. Summary Statistics of Metrics Under the MoF Scenarios

	Type of Fiscal Rule				
	Benchmark	Multiplicative	ACGS	ACL	MSB
Averages over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	24.7	13.0	12.2	19.4	30.4
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.7	0.6	9.8	4.2	16.2
Minimum Debt to GDP	25.3	17.1	13.4	-4.8	17.5
Final Debt to GDP	27.9	23.8	19.6	-1.8	24.0
Maximum Debt to GDP	50.6	51.3	51.0	50.7	50.8
Largest cummulative drop in GG expenditures over one year	-2.8	-1.4	-1.8	-2.0	-3.0
Largest cummulative drop in GG expenditures over two years	-2.8	-2.3	-3.1	-3.3	-5.2
Largest cummulative drop in GG expenditures over three years	-2.8	-3.0	-4.1	-4.1	-6.5
Maximum Notional Account	.	9.8	16.0	.	5.2
Minimum Notional Account	.	-11.3	-9.2	.	-6.4
Number of Years that Debt is Above 40 percent	9.6	7.0	9.0	5.1	6.9
Number of Years that Debt is Above 55 percent	0.0	0.0	0.0	0.0	0.0
Number of Years that the EDP is in place	0.9	5.0	6.3	1.7	7.9
Number of Years the rule is binding (triggers a correction)	0.3	9.7	16.3	6.4	7.3
St. Dev. over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	10.4	14.8	20.0	13.4	17.0
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.6	23.4	29.3	21.6	26.9
Minimum Debt to GDP	3.4	5.6	7.2	10.2	5.6
Final Debt to GDP	4.6	7.8	9.9	11.9	6.0
Maximum Debt to GDP	0.1	0.6	0.8	0.6	0.6
Largest cummulative drop in GG expenditures over one year	1.1	0.3	0.3	0.3	0.8
Largest cummulative drop in GG expenditures over two years	1.0	0.5	0.7	0.7	1.4
Largest cummulative drop in GG expenditures over three years	0.9	0.6	0.9	0.7	1.7
Maximum Notional Account	.	7.3	7.1	.	1.4
Minimum Notional Account	.	4.6	4.7	.	2.5
Number of Years that Debt is Above 40 percent	3.0	1.9	2.6	0.6	1.7
Number of Years that Debt is Above 55 percent	0.0	0.0	0.2	0.0	0.0
Number of Years that the EDP is in place	1.3	1.9	1.9	1.1	2.0
Number of Years the rule is binding (triggers a correction)	0.7	1.9	4.8	1.2	1.9
Average Ranges					
Correlation Expenditure Policy Gap-Output Gap	[-5; 54]	[-31; 59]	[-46; 69]	[-17; 58]	[-30; 72]
Correlation Expenditure Policy Gap-Output Gap in Downturns	[-57; 66]	[-61; 75]	[-70; 80]	[-44; 84]	[-56; 79]
Minimum Debt to GDP	[14; 35]	[-2; 33]	[-19; 29]	[-40; 20]	[-10; 28]
Final Debt to GDP	[17; 46]	[1; 48]	[-19; 44]	[-40; 29]	[0; 40]
Maximum Debt to GDP	[51; 52]	[50; 53]	[50; 60]	[50; 52]	[50; 52]
Largest cummulative drop in GG expenditures over one year	[-8; -1]	[-2; -1]	[-3; -1]	[-3; -2]	[-6; -2]
Largest cummulative drop in GG expenditures over two years	[-8; -1]	[-4; -2]	[-5; -2]	[-6; -2]	[-11; -3]
Largest cummulative drop in GG expenditures over three years	[-8; -1]	[-5; -3]	[-7; -2]	[-8; -3]	[-13; -3]
Maximum Notional Account	.	[-4; 36]	[2; 47]	.	[3; 10]
Minimum Notional Account	.	[-33; -7]	[-31; -1]	.	[-18; -2]
Number of Years that Debt is Above 40 percent	[6; 29]	[5; 15]	[5; 18]	[5; 11]	[5; 12]
Number of Years that Debt is Above 55 percent	[0; 0]	[0; 0]	[0; 3]	[0; 0]	[0; 0]
Number of Years that the EDP is in place	[0; 6]	[0; 11]	[1; 12]	[0; 4]	[2; 13]
Number of Years the rule binds	[0; 4]	[5; 16]	[3; 27]	[4; 10]	[2; 12]

Source: IMF Staff calculations.

Table 5. Summary Statistics of Metrics Under the AWG Scenarios

	Type of Fiscal Rule				
	Benchmark	Multiplicative	ACGS	ACL	MSB
Averages over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	25.4	3.0	9.8	18.4	30.0
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.0	-3.3	7.0	4.4	16.0
Minimum Debt to GDP	30.0	28.4	10.4	-2.1	21.9
Final Debt to GDP	32.3	32.7	19.1	-0.4	28.4
Maximum Debt to GDP	51.5	53.6	53.2	51.8	52.1
Largest cummulative drop in GG expenditures over one year	-2.7	-1.3	-1.8	-1.9	-3.1
Largest cummulative drop in GG expenditures over two years	-2.8	-2.2	-3.1	-3.2	-5.4
Largest cummulative drop in GG expenditures over three years	-2.8	-2.8	-4.0	-3.9	-6.6
Maximum Notional Account	.	-3.2	23.1	.	5.2
Minimum Notional Account	.	-24.2	-12.4	.	-6.5
Number of Years that Debt is Above 40 percent	16.0	21.8	16.1	7.3	14.3
Number of Years that Debt is Above 55 percent	0.0	0.5	0.4	0.0	0.0
Number of Years that the EDP is in place	0.8	6.8	5.8	2.1	7.7
Number of Years the rule is binding (triggers a correction)	0.2	18.1	19.4	8.3	7.3
St. Dev. over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	10.4	16.9	21.4	15.4	16.9
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.5	23.8	31.2	22.4	25.9
Minimum Debt to GDP	4.0	5.1	8.9	13.2	5.4
Final Debt to GDP	4.8	7.2	12.2	14.2	6.3
Maximum Debt to GDP	0.5	2.2	2.4	0.6	0.9
Largest cummulative drop in GG expenditures over one year	1.0	0.3	0.4	0.4	0.7
Largest cummulative drop in GG expenditures over two years	1.0	0.6	0.6	0.8	1.3
Largest cummulative drop in GG expenditures over three years	0.9	0.7	0.9	1.0	1.7
Maximum Notional Account	.	4.0	9.9	.	1.3
Minimum Notional Account	.	6.4	4.4	.	2.5
Number of Years that Debt is Above 40 percent	6.0	5.2	2.9	1.9	3.1
Number of Years that Debt is Above 55 percent	0.2	1.6	1.0	0.0	0.2
Number of Years that the EDP is in place	1.2	2.4	1.9	1.1	2.1
Number of Years the rule is binding (triggers a correction)	0.6	3.0	4.1	1.7	2.0
Average Ranges					
Correlation Expenditure Policy Gap-Output Gap	[-5; 59]	[-46; 69]	[-48; 69]	[-25; 65]	[-14; 75]
Correlation Expenditure Policy Gap-Output Gap in Downturns	[-58; 73]	[-55; 72]	[-68; 80]	[-61; 82]	[-46; 77]
Minimum Debt to GDP	[19; 42]	[10; 40]	[-24; 30]	[-50; 29]	[1; 33]
Final Debt to GDP	[20; 52]	[11; 56]	[-24; 46]	[-50; 42]	[1; 51]
Maximum Debt to GDP	[51; 58]	[51; 66]	[51; 67]	[51; 55]	[51; 62]
Largest cummulative drop in GG expenditures over one year	[-7; -1]	[-3; -1]	[-3; -1]	[-3; -1]	[-6; -1]
Largest cummulative drop in GG expenditures over two years	[-8; -1]	[-4; -1]	[-5; -2]	[-5; -2]	[-10; -2]
Largest cummulative drop in GG expenditures over three years	[-7; -1]	[-5; -2]	[-7; -2]	[-8; -2]	[-13; -3]
Maximum Notional Account	.	[-9; 12]	[3; 63]	.	[2; 11]
Minimum Notional Account	.	[-50; -10]	[-31; -2]	.	[-16; -2]
Number of Years that Debt is Above 40 percent	[7; 35]	[7; 35]	[8; 25]	[5; 15]	[5; 22]
Number of Years that Debt is Above 55 percent	[0; 4]	[0; 15]	[0; 6]	[0; 0]	[0; 3]
Number of Years that the EDP is in place	[0; 7]	[0; 14]	[1; 11]	[0; 6]	[2; 13]
Number of Years the rule is binding (triggers a correction)	[0; 6]	[9; 28]	[5; 28]	[4; 14]	[2; 13]

Source: IMF Staff calculations.

Table 6. Summary Statistics of Metrics Under the MoF Shocked Scenarios

	Type of Fiscal Rule				
	Benchmark	Multiplicative	ACGS	ACL	MSB
Averages over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	25.7	12.8	10.0	19.2	27.7
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.9	1.9	7.8	4.8	14.5
Minimum Debt to GDP	25.4	17.1	13.3	-4.8	17.2
Final Debt to GDP	27.8	23.5	19.8	-1.7	23.9
Maximum Debt to GDP	50.6	51.3	50.9	50.6	50.8
Largest cummulative drop in GG expenditures over one year	-2.8	-1.4	-1.8	-2.0	-3.1
Largest cummulative drop in GG expenditures over two years	-2.9	-2.3	-3.1	-3.2	-5.3
Largest cummulative drop in GG expenditures over three years	-2.9	-3.0	-4.0	-4.1	-6.5
Maximum Notional Account	.	9.6	16.3	.	.
Minimum Notional Account	.	-11.0	-9.1	.	.
Number of Years that Debt is Above 40%	9.8	6.7	8.7	5.1	6.7
Number of Years that Debt is Above 55%	0.0	0.0	0.0	0.0	0.0
Number of Years that the EDP is in place	0.9	4.9	6.1	1.5	7.7
Number of Years the rule is binding (triggers a correction)	0.2	9.6	15.9	6.4	7.2
St. Dev. over 500 replications					
Correlation Expenditure Policy Gap-Output Gap	10.6	14.5	19.5	13.5	18.2
Correlation Expenditure Policy Gap-Output Gap in Downturns	20.5	23.3	27.6	22.2	26.5
Minimum Debt to GDP	3.3	5.7	7.3	10.5	5.4
Final Debt to GDP	4.1	7.5	10.3	12.0	6.1
Maximum Debt to GDP	0.1	0.6	0.8	0.6	0.6
Largest cummulative drop in GG expenditures over one year	1.1	0.3	0.3	0.3	0.8
Largest cummulative drop in GG expenditures over two years	1.1	0.5	0.6	0.6	1.4
Largest cummulative drop in GG expenditures over three years	1.0	0.5	0.9	0.6	1.7
Maximum Notional Account	.	7.2	7.2	.	.
Minimum Notional Account	.	4.0	4.6	.	.
Number of Years that Debt is Above 40%	3.1	1.8	2.6	0.4	1.7
Number of Years that Debt is Above 55%	0.0	0.0	0.1	0.0	0.0
Number of Years that the EDP is in place	1.2	1.8	2.0	1.1	1.9
Number of Years the rule is binding (triggers a correction)	0.6	1.9	5.0	1.2	1.8
Average Ranges					
Correlation Expenditure Policy Gap-Output Gap	[-4; 56]	[-29; 60]	[-40; 67]	[-15; 65]	[-20; 73]
Correlation Expenditure Policy Gap-Output Gap in Downturns	[-59; 68]	[-68; 75]	[-73; 79]	[-61; 80]	[-58; 80]
Minimum Debt to GDP	[16; 35]	[-3; 32]	[-15; 28]	[-43; 20]	[-5; 28]
Final Debt to GDP	[17; 41]	[-3; 48]	[-10; 58]	[-43; 23]	[3; 42]
Maximum Debt to GDP	[51; 52]	[50; 52]	[50; 60]	[49; 52]	[50; 52]
Largest cummulative drop in GG expenditures over one year	[-6; -1]	[-2; -1]	[-3; -1]	[-3; -2]	[-6; -1]
Largest cummulative drop in GG expenditures over two years	[-7; -1]	[-4; -2]	[-5; -2]	[-5; -2]	[-10; -3]
Largest cummulative drop in GG expenditures over three years	[-8; -1]	[-5; -2]	[-7; -2]	[-7; -3]	[-12; -3]
Number of Years that Debt is Above 40%	[6; 27]	[5; 17]	[5; 17]	[4; 9]	[5; 13]
Number of Years that Debt is Above 55%	[0; 0]	[0; 0]	[0; 1]	[0; 0]	[0; 0]
Number of Years that the EDP is in place	[0; 7]	[0; 11]	[1; 11]	[0; 4]	[2; 13]
Number of Years the rule is binding (triggers a correction)	[0; 4]	[5; 16]	[2; 27]	[4; 10]	[2; 12]

Source: IMF Staff calculations.

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