# TECHNICAL ASSISTANCE REPORT

# BOTSWANA

## Enhancing the Forecasting Policy and Analysis System at the Bank of Botswana

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# Contents

# Glossary

| | |
|---|---|
| AR | Autoregressive |
| BoB | Bank of Botswana |
| BVAR | Bayesian Vector Autoregression |
| CPI | Consumer Price Index |
| DFM | Dynamic Factor Model |
| FPAS | Forecasting and Policy Analysis System |
| FT | Forecasting Team |
| GDP | Gross Domestic Product |
| IMF | International Monetary Fund |
| MCM | IMF Monetary and Capital Markets Department |
| MIDAS | Mixed Data Sampling |
| MPC | Monetary Policy Committee |
| MTF | Medium-Term Forecasting |
| NFA | Net Foreign Asset |
| NTF | Near-Term Forecasting |
| NWC | Nowcasting |
| QPM | Quarterly Projection Model |
| UIP | Uncovered Interest Parity |
| TA | Technical Assistance |

# Preface

At the request of Bank of Botswana (BoB), a Monetary and Capital Markets (MCM) Department mission visited Gaborone, Botswana from May 27–31, 2024, to assist the authorities in enhancing their forecasting and policy analysis system.

The mission met with Director Innocent Molalapata and other senior officials. The mission wishes to thank all counterparts for their excellent cooperation, productive discussions, and their hospitality.

# Executive Summary

**This report presents the findings and recommendations from a technical assistance mission that reviewed the Forecasting and Policy Analysis System (FPAS) at the BoB.** The mission focused on several areas designed to support the Bank's policy and analysis function. Work encompassed assessing and advising on both near-term forecasting (NTF) and the medium-term forecasting (MTF) tools and models the Bank has developed.

**Overall, the BoB has a well-organized and disciplined process for integrating the analysis and forecasts to provide policy recommendations to the Monetary Policy Committee (MPC).** BoB's modeling tools within their FPAS have been developed within this context, though there are opportunities for further improvements. The forecasting team (FT) has the necessary toolset and models for a well-functioning system, including a well-tailored quarterly projection model (QPM). The short-term analysis toolkit is well understood, with senior staff demonstrating a solid knowledge of the core model's infrastructure. A substantial amount of data has been assembled for forecasting and policy analysis. However, the databases are spread around the NTF environment and lack sufficient documentation, making tracking and updating difficult. The team is familiar with the current suite of models and committed to learning, developing, and enhancing the infrastructure. However, GDP (Gross Domestic Product) nowcasts based on a leading indicator produced with machine learning techniques could be (i) better integrated with the near-term forecasts, (ii) more efficiently updated and (iii) better maintained, understood and documented. The NTF toolkit could be expanded to include more flexible approaches beyond vector autoregressive (AR) models, and with higher quality forecasts. Additionally, the MTF tool lacks a proper fiscal block to analyze the government's fiscal plans and scenarios.

**The mission team introduced enhancements to the NTF modelling approaches to improve the FPAS infrastructure.** The mission team helped create a new 'global' database to centralize data streams and introduced a new flexible platform with a suite of models that expands and complements existing NTF models. The new Nowcasting (NWC)/NTF model is comprised of about 80 models, covering 5 model classes (i.e., AR, Bridge, Mixed Data Sampling (MIDAS) Regression, Bayesian Vector Autoregression (BVAR) and, Dynamic Factor Model (DFM)). This platform is flexible (e.g., users can choose different forecast variables, relevant indicator variables, and model specifications), tractable (i.e., users can easily investigate model properties and performance), and quick to update. The new platform includes model performance evaluation procedures to enhance NWC and NTF analysis. As part of this effort, the core NTF projection environment was also revamped and updated by reorganizing and streamlining the core model infrastructure. The mission team also equipped the staff with training documentation and demos to advance their technical coding capacity.

**The mission team also improved the MTF framework by reviewing the existing model calibration, introducing a fiscal block, and recommending further adjustments**. The mission team discussed with staff the process of exchange rate determination in the model and the adequacy of the existing calibration of model parameters, using impulse response functions. Given the current literature on the endogenous credibility of a central bank (which makes the modeling exercise strongly non-linear), the mission team recommended that staff remain aware of the implications of assuming an exogenously-given full credibility of the exchange rate target. After adding the fiscal block to the MTF model, which captures the

key transmission channels of fiscal policy decisions (its impact on economic activity as well as on risk premia and the external sector position), the team discussed the interpretation of the output gap, linking it to price stability.

**Overall, it is recommended that the BoB centralize its data management system to facilitate better access, organization, and analysis of economic indicators.** This centralization will streamline the forecasting process and improve the reliability of projections. Additionally, a key aspect of the recommendations includes improving the documentation for both NTF and MTF models, with a specific suggestion to publish a working paper that outlines the methodologies and findings. This will not only enhance transparency but also serve as a valuable resource for ongoing training and development.

**It is also crucial to allow more time for the development of NTF and MTF models between policy cycles.** This will enable staff to thoroughly refine the models and incorporate feedback, leading to more accurate and robust forecasts. Ongoing training programs are essential to develop staff technical skills and ensure they are familiar with the latest modeling techniques. By fostering a culture of knowledge sharing and collaboration between sectoral experts and modeling units, the BoB will enhance its forecasting capabilities and ensure that its staff remains engaged and proficient in utilizing the forecasting tools effectively.

# Recommendations

**Table 1. Key Recommendations**

| | Priority | Timeframe[1] |
|---|---|---|
| **Data and Database Management** | | |
| Increase coordination across sectoral experts and NWC/NTF/MTF forecasting units. | High | Near-term |
| Expand NTF database with higher frequency indicators. | Medium | Medium-term |
| Centralize all FPAS-related data management overseen with a specialized unit (e.g., data and statistics office) that is responsible for managing and updating data streams across units. | Medium | Medium-term |
| **Nowcasting and Near-term Modeling** | | |
| Improve model documentations to retain institutional knowledge and facilitate knowledge transfer. | High | Near-term |
| Allow time for the development of models and enhancement of projection practices and procedures. | High | Near-term |
| Continue expansion and development of new NTF platform with the addition of new models and techniques. | Medium | Medium-term |
| Merge newly enhanced NTF environment with MTF infrastructure. | Medium | Medium-term |
| **Medium-term Modeling** | | |
| Further match model properties (impulse responses, estimates of unobserved variables) to intuition of model builders, previous studies and MPC priors. | High | Medium-term |
| Allocate more time to modelling exercises beyond the MPC cycles (e.g., trying on different model extensions). | High | Near-term |
| Consider writing a working paper documenting the FPAS, core model, transmission mechanisms incorporated in it and its application results. | Medium | Medium-term |
| Further deepen each team member's modeling skills (e.g., partaking in IMF trainings on modeling). | High | Medium-term |
| **Policy Formulation Process and Communication** | | |
| Communicate relevant risk scenarios to inform the public about the Bank's monetary policy reaction function. | Medium | Medium-term |

[1/] Near term: < 12 months; Medium term: 12 to 24 months.

# Introduction

**1. Monetary policy in Botswana follows a ranked dual mandate, prioritizing price stability, while also incorporating financial stability.** Within the current policy framework, BoB's MPC meets regularly to make decisions about its Monetary Policy Rate. The price stability objective is defined as a range of 3 to 6 percent to be achieved over a medium-term horizon of 3 years. The BoB states that the framework is based on inflation forecast. However, while sharing some similarities, the framework does not amount to inflation targeting, since BoB also implements a crawling exchange rate peg, where the Pula is pegged to a basket of currencies (currently, the South African rand and the IMF's Special Drawing Rights). This means that while the MPC's policy rate decisions require an analytical framework in support of inflation/macroeconomic forecasting and policy analysis, it should incorporate the Botswana-specific aspects of the framework, including key interactions between the policy rate rule and exchange rate policy. This is important since the inflation projection-driven policy rate may not always be consistent with the interest rate required to maintain the crawling peg, and the MPC needs to have this explicitly incorporated into the analysis.

**2. BoB's modeling tools within their FPAS have been developed within this context, but opportunities for further improvements remain.** The FT has the toolset and models for a well-functioning system, including a well-tailored QPM. Additionally, previous IMF TA missions in recent years have helped strengthen the NTF framework and upgrade the database, data process, and FPAS infrastructure at BoB. However, GDP nowcasts based on a leading indicator produced with machine learning techniques could be (i) better integrated with the near-term forecasts, (ii) more efficiently updated and (iii) better maintained, understood, and documented. The NTF toolkit could be expanded to include more flexible approaches beyond vector AR models, and with higher quality forecasts.

**3. The 2024 mission is part of a multi-year engagement with BoB to modernize and enhance its monetary policy framework and strengthen its model-based policy analysis capabilities.** Prior missions focused on introducing a Business Expectation Survey, a composite economic indicator index, and additional tools and indicators to improve NTF and provide GDP nowcasting capabilities.

**4. The current mission assisted the BoB in further developing the FPAS by enhancing the Bank's capacity for model-based policy analysis and forecasting.** The mission helped centralize the data inflow used by the core nowcasting and NTF projection environment and revamped the core NTF model infrastructure. The mission also introduced enhancements to the core model that better characterize the evolution and interactions between fiscal policy variables and the trajectory of interest rates in the medium-term forecast. This will enable staff to conduct relevant and coherent alternative scenario analysis and better inform monetary policy decision-making.

**5. The mission also diagnosed the BoB's toolkit and implemented enhancements to the existing infrastructure.** A centralized database for conducting NTF forecasts was created, and the current core NTF infrastructure was fully revamped, bringing together the various tools in an efficient and unified manner. The mission also developed a flexible model platform for NWC/NTF that is fully integrated into the BoB FPAS and uses a suite of models, covering 5 model classes (i.e., AR, Bridge, MIDAS, BVAR, and DFM). This platform can be easily expanded with other model classes, forecast variables and indicators and its forecast performance can be assessed regularly using a built-in out-of-sample

performance procedure. The mission also assessed the organizational, human, and technical resources of Bank staff in utilizing the core model for near- and medium-term forecasts and provided technical training, demos and documentation to enhance the technical knowledge behind MATLAB and EViews, the key software used to run the current FPAS tools.

# I. Conjunctural Analysis and the NTF

**6. The NTF process has benefited from numerous indicators and data sources but faces challenges with limited documentation.** Staff have collected data at both monthly and quarterly frequencies. Some of these indicators come with forecasts from external sources, which can aid in conducting conditional forecasting. However, the databases used to store this data were dispersed throughout the NTF environment and had limited documentation, making tracking and updating challenging. Discussions with sectoral experts, who are not yet fully integrated into the NTF process, revealed opportunities to expand the NTF database with higher frequency data, such as business cycle indicators.

**7. The core NTF model, while well maintained and supported by knowledgeable senior staff on its infrastructure, suffers from a lack of clear organization.** Despite well-documented scripts, the overall infrastructure lacked clear organization, particularly given the numerous reports, graphs, models, scripts, and data inputs required for the NTF process. Additionally, there were limited tools to easily compare the evolution of the outlook to previous projections. The core NTF model consists of a single BVAR for (non-mining) GDP and separate ones for core, food, and oil CPI (Consumer Price Index), featuring a convenient element for including and tracking NTF judgment. Meanwhile, alternative models (Machine Learning Algorithms) were being run on the side, but the process to update this infrastructure was opaque, inflexible, poorly documented, and time-consuming. This disconnection from the core NTF process made analysis during the policy cycle more difficult. Consequently, a key missing element within the standard NTF toolkit was a flexible model platform that could leverage insights from alternative model classes while being easily tractable, updated, and integrated within the core infrastructure.

## A. Strengthening Database Management

**8. A new 'global' database was created to centralize the data inflow used by the core NWC/NTF projection environment.** The database combines all available data, indicators, and external forecasts used in the projection. It features descriptive tables that summarize variable mnemonics, characteristics, and data sources, together with a built-in search function to quickly extract variable information.

**9. The core NTF projection environment was also revamped and updated by reorganizing and streamlining the core model infrastructure.** The new environment now includes a clear folder structure with predetermined locations for all reports, graphs, models, scripts, functions, data inputs, and final outputs, improving tractability, order, and efficiency. A new graphing tool also complements the new infrastructure, helping isolate changes in NTF projections and data inputs relative to earlier versions.

## B. An Integrated Platform for NTF Models

**10. A new NWC/NTF model platform was developed comprising over 80 models, covering 5 model classes** (i.e., AR, Bridge, MIDAS, BVAR, and DFM). The new platform is flexible (e.g., users can choose different forecast variables, relevant indicator variables, and model specifications),

tractable (i.e., users can easily investigate model properties and performance) and quick to update (i.e., the platform can be updated in under 2 minutes).

**11. The new platform is fully integrated into the existing core NTF model infrastructure.** As a result, economists can compare the evolution of the core NTF forecast with those produced by the new platform to help inform their judgment and final staff outlook. The performance of the forecasts from the new platform can be assessed in real-time using the built-in out-of-sample performance procedure developed within the new platform.

**12. Training, reference materials, demos and documentation were provided as part of the mission.** This should help staff at the BoB expand their technical knowledge and expertise in using the core NTF infrastructure and the new model platform.

## C. Recommendations

**13. Senior members of the department should allocate time for model maintenance and development.** Some concrete examples could include: (I) conducting periodic meetings following policy cycles where staff can share 'lessons learned' and challenges faced during the MPC process, (II) completing 'model change' presentations to transfer knowledge and encourage experimentation with the model, and (iii) drafting 'modelling news' where staff can report model properties and model changes to senior staff.

**14. Unifying sectoral experts and the Modelling Unit or encouraging close interaction and communication between them would increase the efficacy of the forecast process.** The deep data knowledge and understanding of recent events (currently performed by the sectoral experts/unit) would be highly beneficial for conducting an accurate near-term forecast (currently performed by the Modelling Unit).

**15. Staff should regularly maintain the new global database and expand it with new indicators.** In the near term, the mission recommended optimizing the updating processes with sectoral experts (ideally, both NTF and sectoral experts would update a single database, not multiple ones spread around the department). In the medium term, efforts should be made to centralize all FPAS-related data management using a centralized data office, ideally located in the Modelling Unit.

**16. The mission also recommended merging updates made to the NTF infrastructure with the MTF environment, and weighting model outputs with forecast performance.** This would streamline the process of initializing conditions for the MTF with inputs from the nowcasting and NTF exercises. Furthermore, the new model NTF platforms should be expanded with new forecast variables, indicators, and modeling approaches. Also, staff should work to complete periodic out-of-sample performance evaluations across core models and the new NTF model platform to assess the optimal weighting scheme across the various model classes.

**17. Risks to implementing the mission's recommendations on the NTF framework center around data management and inadequate resources for training and model development.** Insufficient time for training on the newly developed models and infrastructure might lead to their deterioration over time. Similarly, limited documentation related to the new and existing FPAS toolkit might hinder knowledge transfer with new employees. Lack of specialization in tasks performed within

the Modelling Unit could prevent the proper development of models and infrastructure, keeping knowledge at a superficial level and concentrated among a few members of the Unit. Finally, manual data updates across sectoral experts and the Modelling Unit could lead to data errors and inefficiencies within the department.

# II. Medium Term Forecasting Tools and Models

**18. The BoB processes for linking the current analysis with medium-term forecasts and policy recommendations are well organized, but the underlying analysis could be further strengthened.** The MTF model lacked a proper fiscal block that would allow analysis of the government's fiscal plans and scenarios, in line with the MPC's analytical needs. This is especially relevant in a crawling exchange rate peg regime, which BoB utilizes, since in such a regime fiscal policy has an important impact on demand and inflation as well as exchange rate pressures.

**19. Notwithstanding periodic need for certain QPM extensions, the model already has some important features needed to assess the current state of the economy and to provide internally consistent forecasts.** The staff is also competent to conduct such analysis. The challenge remains to allocate sufficient time of the staff for model development, beyond the forecasting exercises for each MPC cycle.

**20. Although the QPM helps produce an internally consistent macroeconomic story, ultimately, it is the staff that provides the monetary policy advice to the MPC.** Hence, sufficient time should be devoted to get familiar with the model's propagation and transmission mechanisms, consistent with key stylized facts of the Botswana economy. Hence the need for broader macro research as well, especially on scrutinizing the empirical relevance of different transmission channels in the Botswana economy.

## A. Reviewing the Model Dynamics

**21. The mission team and the staff went through the current calibration of the model using a proper impulse response analysis.** The QPM was subjected to many different shocks, and the model's propagation mechanism was assessed. This helped improve the team's familiarity with the inner workings of the model and transmission channels captured in it. It was assessed that the calibration captures the key stylized facts well enough, apart from its response to fiscal shocks, which was upgraded only afterward.

**22. During the impulse response analysis, it became apparent that implicit assumptions behind the QPM may not have always been fully appreciated in the team's FPAS work.** For instance, the process of exchange rate determination in the model was not usually discussed critically. The mission team emphasized that the MTF model assumes an exogenously given full credibility of the exchange rate target. However, in reality, the credibility depends on the severity of the shocks hitting the economy and, more importantly, on how the central bank reacts to them. The mission team also advised the staff to always remain conscious of these assumptions and make necessary changes in scenarios if need be. Incorporating an endogenous credibility would suggest that if the shock creates exchange rate pressures and the public starts questioning the peg, then the central bank would have to go the extra mile in counterbalancing these pressures, as opposed to the full credibility case, where stable long-run exchange rate expectations mitigate the pressures on their own without much policy reaction. Incorporating an exogenous but less-than-full credibility is also a partial but easier solution to this modeling problem. Namely, assuming that exchange rate expectations depend not only on model-

consistent expectations, but also on the current measure of exchange rate pressures (like risk premium or interest rate differentials) could help in this direction.

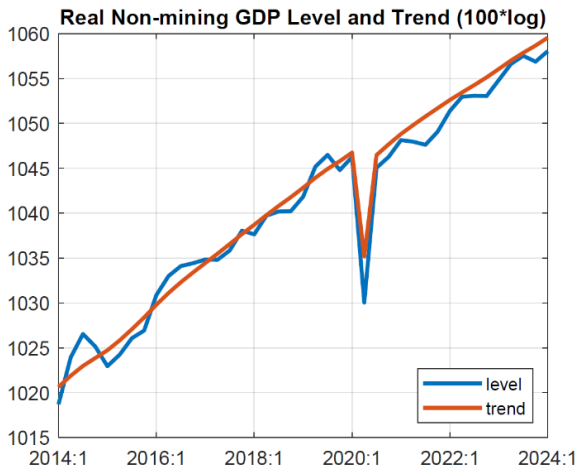
**23. The staff also had difficulty explaining the concept of an output gap to MPC members.** Namely, some MPC members questioned the adequacy of output gap estimates when they showed positive numbers (i.e., the economy operating above capacity) but unemployment in the country remained high. The mission team emphasized that output gaps in the monetary policy context should be linked to the price stability objective, i.e., the level of output that doesn't generate excess price/wage pressures, as opposed to a level of output that would have prevailed if the economy had not been subject to (labor market) frictions.[1]

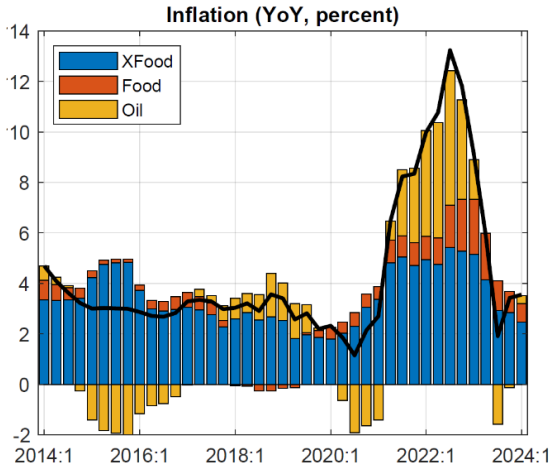
**24. With that question in mind, the team summarized the output gap estimates based on the QPM and its interpretation.** This Kalman-filter estimated output gap can be seen in Figure 1 as the difference between the actual GDP and its estimated trend (i.e., potential GDP).[2] The FT allowed the filter to fit the potential GDP with all the observable variables provided to the Kalman filter procedure, except for the COVID-19 period. For the latter period the team judgmentally incorporated a big drop in potential GDP to make the output gap estimate consistent with the idea of sudden lockdowns (and their later reversal) that had unusually large impact on productive capacities. Overall, the output gap estimate is in line with inflation dynamics over the years if other inflation drivers are also taken into account (which it is by the augmented Phillips curve). For instance, if the output gap were to be estimated at deeply negative rates (as was initially suspected by the MPC members based on the unemployment data), then inflation acceleration (especially in the non-food part) would not have been as high as it actually was. Another example is around 2014 when output gap showed an acceleration into a positive territory, which was followed by a pickup in non-food inflation, as would be expected with a positive output gap. For the latest period (2024Q1), output gap is estimated at about -1.5 percent, generating slight but still negative pressure on non-food inflation, which in fact does show moderation recently.

[1] The same distinction is also made in the academic macroeconomic modeling literature.

[2] Here we show the non-mining GDP gap and its trend, since non-mining output gap is more closely related to a business cycle position and medium-term inflation dynamics, relative to the mining output gap, which mostly depends on foreign demand for diamonds.

**Figure 1. Real Non-Mining Output, Potential Output and Year-on-Year Inflation Rates**




Source: Bank of Botswana and TA Mission Calculations.

## B. Adding a Fiscal Block

**25. The mission team helped add a fiscal block to the MTF model that would be used especially for fiscal scenario analysis.** The work consisted of discussing with the staff the major ways through which fiscal policy affects the economy and capturing the key transmission channels of fiscal policy decisions in the QPM. Two critical transmission channels identified were the fiscal impulse's impact on economic activity/output gap and its impact on the external sector position of the economy and, therefore, the Uncovered Interest Parity (UIP) risk premia.

**26. While the technical work of the fiscal extension was done by the mission team, the staff mirrored the steps on their own computers in real time, emphasizing their technical capacity.** This will be important given that the newly introduced fiscal block will need occasional tweaks to capture any peculiarity of fiscal policy in a given period, including how to modify tunes/judgment on fiscal policy variables in scenarios.

**27. During the mission, three alternative measures of a fiscal impulse were considered.** The first measure was specifying a process for the structural budget deficit and identifying the fiscal impulse as unexpected changes in the structural deficit (i.e., a shock). The second was defining the fiscal impulse in terms of a change in the structural deficit, while the last defined it as a deviation of the structural deficit from its long-term average/steady state. After careful comparison of impulse responses from the QPM and general discussions about how fiscal policy affects the economy, the first approach to defining the fiscal impulse was chosen. This fiscal impulse was then incorporated into the non-mining output gap (dynamic IS) equation as well as into the UIP risk premium equation. The latter modification is meant to capture the impact of fiscal policy on the exchange rate through the current account deficit and, hence, the net foreign asset (NFA) position of the country. Namely, if the NFA deteriorates because of a wider current account deficit due to fiscal expansion, then the external debt position would necessitate future real depreciation to gain external competitiveness. The latter can come only from two places: 1) nominal depreciation, which is usually what flexible exchange rate countries follow, or 2) internal

devaluation, with inflation remaining low relative to trading partners (e.g., due to high domestic interest rate differential, which is part of the UIP equation).

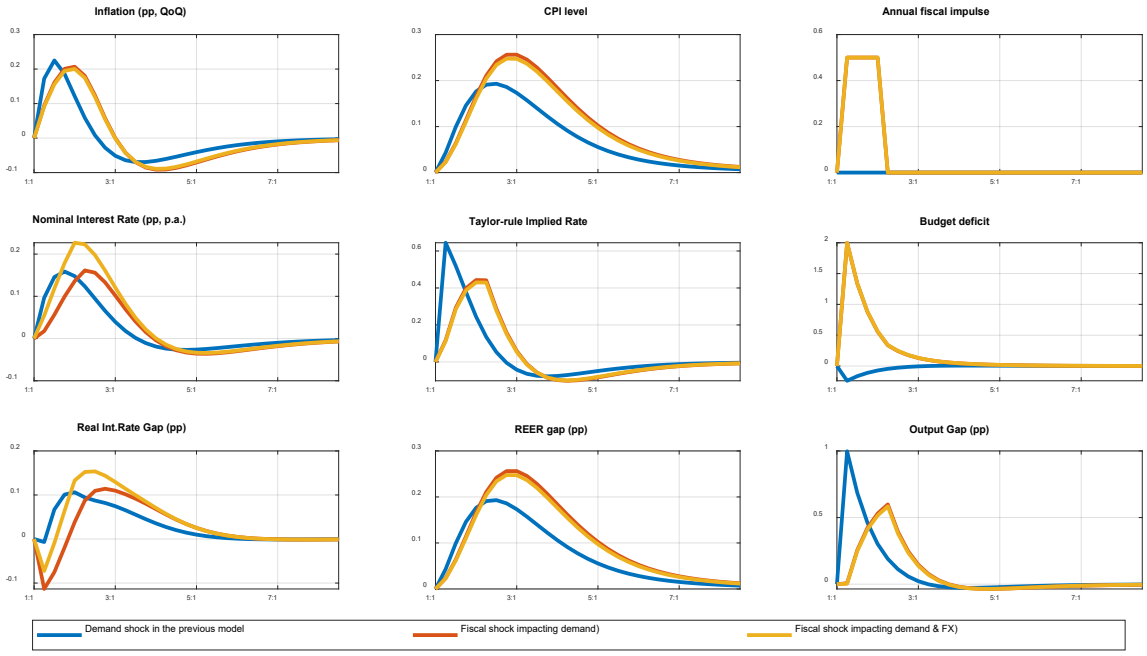
**28. The most direct way to summarize the marginal changes related to the introduction of fiscal shocks is by comparing impulse response functions across the previous and updated versions of the QPM.** Figure 2 shows those impulse responses for positive demand/fiscal shock scenarios. In particular, it shows how the model economy reacts to a standard aggregate demand shock in the previous version of the QPM (since it had no fiscal shocks) as compared to responses to a fiscal shock within two versions of the updated QPM: (i) when the fiscal impulse is just impacting the output gap and (ii) when the fiscal impulse is impacting both the output gap as well as exchange rate pressures (through its impact on the current account deficit[3] and, hence, the UIP risk premium).

**29. As evident from the impulse responses, adding the fiscal impulse variable better reveals the importance of a stronger and more persistent policy rate reaction to fiscal shocks.** The need for a policy rate reaction is underestimated by the previous model, even though the initial size of the shocks is calibrated to have exactly the same first-round impacts across all scenarios. The updated model brings this additional perspective because of the fiscal impacts appearing in two places, each having the following marginal effects: (i) as captured by the updated output gap equation, budget expenses in the model (and usually in the real world as well, including in the case of Botswana) are expected to be carried out gradually over several quarters, impacting future inflation expectations more than a one-off standard demand shock even if overall similarly sized; (ii) as captured by the updated UIP risk premium equation, increases in the fiscal deficit (partially) lead to increases in the current account deficit that strengthen the exchange rate depreciation pressures, thus requiring more aggressive policy rate response to maintain the peg. Both of these effects, even though they represent only simple changes in the QPM, are in line with the team's general understanding of the fiscal effects in Botswana as well as the macroeconomic literature emphasizing the role of fiscal shocks for inflation, especially for countries with pegged exchange rate regimes (see Cevik and Miryugin, 2023).[4]

[3] This incorporates the idea of the so-called twin-deficits.

[4] Cevik, M.S. and Miryugin, F., 2023. It's Never Different: Fiscal Policy Shocks and Inflation (No. 2023/098). International Monetary Fund.

**Figure 2. Impulse Responses to a Demand Shock (for the Previous Model) and a Fiscal Shock (for the Updated Model)**




Source: IMF TA Mission Calculations.
Note: pp: percentage points, p.a.: period average.

## C. Recommendations

**30. Efforts to facilitate skills transfer and enhance the modeling capacity of staff should continue.** Knowledge of the workings of the model seems to be concentrated in a couple of staff members. Hence, skills transfer and modeling capacity building is a priority to ensure the sustainability of the FPAS in general. This means allocating more of the staff's time for modeling exercises—e.g., reviewing calibration, extending the model in certain directions, and cleaning the model codes. As such, management should further deepen each staff member's modeling skills by partaking in IMF trainings on modeling, e.g., Model-Based Monetary Policy Analysis and Forecasting (MPAF) by the IMF's Institute for Capacity Development (ICD).

**31. The QPM infrastructure would benefit from documentation that tracks all the changes at each step of development.** This includes documenting the fiscal extension, steps taken during the mission to incorporate it, as well as instructions on how to use it during forecasting rounds.

**32. Staff should consider writing a working paper documenting the core model, transmission mechanisms incorporated in it, and its application results, focusing on the macroeconomic story.** This, along with publishing relevant risk scenarios, will help the BoB's public communication of its decisions. Such a working paper would also help preserve institutional knowledge and facilitate intergenerational skill transfer within the institution. Finally, the working paper can serve as a key reference for future iterations of the core model.

**33. The mission also recommended that staff further match core model properties to the intuition of model builders, previous studies, and priors of MPC members about the Botswana economy.** Calibration of key model equation parameters (that affect the model's propagation mechanism) as well as that of standard deviations of the shocks (that affect the Kalman filter results) should be checked regularly. Doing so will ensure that the dynamic properties of the model are consistent with BoB's understanding of monetary policy transmission in the Botswana economy and add credence to the narrative around the forecasts and shock decompositions.

**34. Key-person risk remains an important implementation risk.** Sustaining a well-functioning FPAS requires fully documenting all modeling exercises (especially relevant for staff recently exposed to FPAS) and, more importantly, continually enhancing the technical capacity of the staff. If the few staff members who have specialized knowledge of the QPM leave the institution, the FPAS sustainability could be threatened. Also, if the staff do not attempt different calibrations and model extensions, the model/calibration could gradually become outdated and fail to capture important aspects that MPC members may be concerned about.

**35. The next steps for further improvement of the framework will be discussed at a future date.** Once the report is transmitted to the authorities and the implementation of the recommendations is underway, a future visit to Gaborone could detail these next steps.