



# RWANDA

## TECHNICAL ASSISTANCE REPORT –EXPANDING THE NOWCASTING TOOLBOX AT THE NATIONAL BANK OF RWANDA

December 2023

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# TECHNICAL ASSISTANCE REPORT

## **RWANDA**

### EXPANDING THE NOWCASTING TOOLBOX AT THE NATIONAL BANK OF RWANDA

**MARCH 2023**

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**GLOSSARY**

AFE	IMF's Regional Technical Assistance Center for Eastern Africa—AFRITAC East
ARMA	Auto Regressive Moving Average
BoP	Balance of Payments
CPI	Consumer Price Index
COICOP	Classification of individual consumption by purpose
DFM	Dynamic Factor Model
DG	Deputy Governor
EA	External Assumption
GDP	Gross Domestic Product
IC	Initial Condition
ICD	Institute for Capacity Development
FPAS	Forecasting and Policy Analysis System
FT	Forecast Team
MCM	Monetary and Capital Markets Department
MP	Monetary Policy
MPC	Monetary Policy Committee
MPF	Monetary Policy Framework
MPR	Monetary Policy Report
MPRD	Monetary Policy and Research Directorate
NA	National Account
NBR	National Bank of Rwanda
NBS	National Bureau of Statistics
NTF	Near-Term Forecast
QPM	Quarterly Projection Model
STX	Short-term Experts
TA	Technical Assistance
VAR	Vector Auto Regressive

**PREFACE<sup>1</sup>**

In accordance with IMF Monetary and Capital Markets Department (MCM) and AFRITAC East (AFE) technical assistance (TA) project on Forecasting and Policy Analysis System (FPAS), a virtual TA mission on “*Expanding the nowcasting toolbox at the National Bank of Rwanda*” (NBR) took place during December 12–21, 2022. The mission team comprised Messrs. Eilert Husabø and Pål Bergset Ulvedal (STXs, the Norges Bank), and Ms. Jianping Zhou (Mission Chief, MCM).

The daily technical sessions were attended by senior managers and staff from the forecasting teams of the Monetary Policy & Research Directorate. Separate daily sessions were held for the GDP nowcasting team and the CPI inflation nowcasting team. Mr. Thierry Mihigo Kalisa (Chief Economist of the NBR), Mr. Mathias Karangwa (Director of Research Department), and Mr. Bruno Mwenese (Head of Forecast Division) joined the opening and concluding sessions.

The mission would like to thank the NBR staff and management for the engaging and productive discussions.

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<sup>1</sup> The report was sent to the NBR for review in January and all factual comments have been included.

## EXECUTIVE SUMMARY

In response to a request from the National Bank of Rwanda and in accordance with the AFE workplan, a virtual technical assistance (TA) mission on Forecasting and Policy Analysis System (FPAS) took place during December 12–21, 2022. The objectives of the mission were: (i) further strengthening the nowcasting framework for GDP and CPI inflation, and (ii) initiating the work on developing a simple, efficient, and robust process for forecasting the external variables for the Quarterly Projection Model (QPM). The mission built on the progress made during the March 2022 mission, which focused on improving the nowcasting framework for the key domestic variables (including CPI and GDP) and building tools for analyzing new data releases and assessing the nowcasting systems.

The mission completed its planned tasks: it (1) improved the nowcasting frameworks for GDP growth and CPI inflation by expanding the nowcasting toolbox and building templates for presentations for forecast meetings and internal toolboxes for analyzing new releases of GDP and inflation data; (2) implemented a system for forecast error analysis and used that system in historic forecasts for GDP and inflation; and (3) unified and simplified the external database by replacing the current system (multiple and ad-hoc databases) with one database for historical external data and one database for external forecast. In addition, the mission also helped set up Excel programs to produce high quality charts for the monthly Monetary Policy Reports, rather than the current practice of copying and pasting PDF charts. A detailed presentation for the concluding sessions—one with the senior managers and other with the forecasting teams—was shared with the authorities at the end of mission.

Going forward, the TA should continue to focus on the developments of the nowcasting framework for inflation and GDP. Specifically, the new CPI and GDP Near-Term Forecast (NTF) tools should be used on a monthly basis as part of the forecasting process and FPAS work at the NBR. The new CPI NTF system now includes the monthly forecasts of ten subgroups of the core CPI inflation as well as two subgroups of food inflation, thus enabling the assessment of the key drivers of inflation as well as the nature of inflation shocks. It also allows for the “real time” monitoring of monthly inflation outcomes relative to the forecast. Similarly, the new GDP NTF system focuses on forecasting production in the different sectors and significantly improves the forecasting results. The authorities should consider phasing out the current dynamic factor model (DFM) and replacing it with the new model system developed during this mission that has demonstrated better forecasting performance. The analysis based on these new NTF systems would provide crucial input for the nowcast and the nowcast meeting during the forecast process. Moreover, improving the forecasts of foreign variables and external assumptions for commodity prices should be a priority going forward. While improving internal capacity remains the long-term objective, using external providers is currently more efficient than relying on in-house forecasting, given the resource constraint and the need to focus on improving the forecasting of the domestic economy. Last, but not least importantly, the FPAS needs to be fully integrated into the monetary policy decision-making process. There needs to be more permanent staff working on the

FPAS and additional IMF TA could be helpful in strengthening the NBR's monetary policy process.

**Table 1. Key Recommendations**

<b>Recommendations and Authority Responsible for Implementation</b>	<b>Priority</b>	<b>Timeframe<sup>1</sup></b>
<b><i>Forecasting and Policy Analysis System</i></b>		
NBR should continue work on establishing a simple, robust, and efficient system for producing external assumption forecasts for the policy model. The system should be managed by at least two persons, be based on forecasts from outside providers (such as Macro Bonds/Bloomberg consensus), and allow for efficient monitoring of external developments. <sup>2</sup>	High	Near-term
NBR should replace charts in Monetary Policy Reports that are currently with the charts produced at this mission.	High	Near- term
NBR should consider phasing out the current dynamic factor model (DFM) for GDP nowcasting and replacing it with the new model system developed during this mission that has demonstrated far better forecasting performance.	High	Near-term
NBR should continue refining the newly developed models in the NTF system for the twelve main CPI COICOP groups. This should be done with a view to increase understanding of inflation dynamics, and with a goal to move from forecasting core, energy, and food inflation directly, to forecasting these three groups bottom-up.	Medium	Medium-term
<sup>1</sup> Near-term: < 12 months; Medium-term: 12 to 24 months.		

<sup>2</sup> When this report was prepared, there was only one NBR staff operating the CPI nowcasting. According to the authorities, the team has been expanded to include three staffs and one young economist.

## I. INTRODUCTION

- 1. The NBR started implementing a price-based monetary policy framework in January 2019 and has since made good progress in developing a model-based FPAS framework to support the operation of the new framework.** The FPAS framework generates model-based forecasts, which are presented to the MPC as an input for the monetary policy decision and published in the quarterly monetary policy reports. In 2020 the AFE resumed full responsibility for the FPAS TA project at the NBR and since then there have been several engagements in a mix of regular TA missions, bilateral and multilateral workshops.
- 2. The FPAS framework includes three technical elements: the frameworks for analyzing and forecasting foreign developments, the nowcasting framework, and the Quarterly Projection Model (QPM).** The latter is more developed at the NBR compared with the former two and yet their results provide crucial inputs—external assumptions and initial conditions—to the QPM model that produces medium-term inflation forecasts and the model-based policy responses.
- 3. Therefore, the last three TA missions all focused on developing the nowcasting framework at the NBR.** The nowcasting frameworks at central banks are the responsibility of the sector experts and the nowcasting team. Their expert contribution to the forecast is essential for storytelling. Their deep knowledge of key sectors/variables and their understanding of economic developments and drivers are crucial additions to the results of tools and models. Hence, a sophisticated nowcasting framework requires a dedicated team of experts equipped with a large set of analytical tools and models.
- 4. As the progress with developing the FPAS has been swift at the NBR, human resources are becoming a binding constraint for further progress.** Previous TA missions have already emphasized the need to strengthen the QPM team and understands that this is currently being done. It is also the mission’s understanding that the size of the nowcasting team has been somewhat expanded. However, both the nowcasting and QPM teams are still smaller than in most inflation targeting central banks and seem to dedicate only part of their time on FPAS-related work. FPAS encompasses monitoring developments, developing tools and models, conducting forecast error analysis, updating forecasts (also in between official forecasts rounds), and contributing to internal and external communication. The nowcasting team should be freed up to continue developing FPAS with a view to maintain sustainability and credibility with the FPAS. As the FPAS at the NBR is becoming more and more sophisticated and elaborate, the workload of running existing system and expanding the understanding of the economy will continue to increase.
- 5. Although the NBR is struggling with human resource constraints on the regular FPAS work, there is always good staff attendance during TA missions, as was the case this time.** The mission worked in two nowcasting streams. The nowcasting streams focused

respectively on CPI and GDP each had an average of 4-5 staff taking active part in the development work.

## II. THE NOWCASTING FRAMEWORK

**6. The nowcasting framework within FPAS is much more than models and typically managed by a team of sector experts,** with 1-3 staff members responsible for each key variable/sector such as inflation, real sector activity/GDP, fiscal performance, labor market, and other primary sectors in the domestic economy. The nowcasting team is responsible for monitoring these variables/sectors, and for developing and running analytical tools and models in both aggregate and disaggregate form. They perform forecast error analysis, provide judgements (often also on the longer horizon), help interpret the near and medium-term forecast, provide input text for the Monetary Policy Report (MPR) and draft internal memos of new data releases. Their expertise, tools, models, and tasks differ from those of the core model team and therefore they also often belong to separate divisions within the Research department<sup>3</sup> or may even come from different departments within the NBR but mostly from the Monetary Policy and Research Directorate (MPRD).<sup>4</sup>

### A. The Nowcasting System for CPI

The two previous FPAS missions have focused on developing tools for analyzing inflation outcomes and on building a system of models for nowcasting inflation.

**7. During the September 2021 mission, several tools were developed to facilitate deeper disaggregate analysis of inflation to facilitate for a better understanding of inflation dynamics and underlying inflationary pressures.** Such tools also help to build a story, to motivate inflation developments and inform judgmental adjustments to the forecast. Moreover, it is often in the details on the disaggregate level that sources of forecast errors are found. Understanding the errors made in the previous forecast is crucial for the current forecast. NBR staff regularly use the tools developed during this mission. Output from the tools, such as charts and measures of underlying inflation, are also used for communicating inflation developments in the NBR's Monetary Policy Reports (MPRs).

**8. During the March 2022 mission a system of nowcasting models based on different indicators/explanatory variables was developed.** The system was built on out-of-sample forecast error calculations and model averaging. It covered headline, core, food, and energy inflation. The refined system outperformed a benchmark autoregressive–moving-average (ARMA) and the existing Vector Auto Regressive system (VAR) on all relevant horizons for nowcasting e.g., up to six months.

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<sup>3</sup> The Research department has two divisions: (1) Economic Research, and (2) Modeling and Forecasting.

<sup>4</sup> The MPRD has three departments: (1) Research; (2) Monetary policy, and (3) Statistics.

**9. This mission in December 2022 refined the output from previously developed tools, extended the NTF-system to forecast headline and core CPI from the 12 main COICOP groups,<sup>5</sup> trained NBR staff further on how to use the tools, and developed a toolbox for bridging the gap between the NTF-system and the policy model.** This framework directly addressed requests made by the inflation forecast team at the NBR. The December 2022 mission also focused on the importance of conducting regular forecast error analysis and developed a framework to this end.

**10. The system for bridging the gap between nowcasts and the policy model (the Inflation Dashboard, see Figure 3) was built in Excel.** In terms of short-term forecasts, the inflation FPAS at the NBR consists of forecasts for core, food, and energy CPI for horizons one to three months ahead that are fed into the policy model. Previously, the inflation forecast team has focused solely on forecasts on a quarterly frequency, and then only on growth rates and not level indices. Judgement to the forecasts has been added on an ad hoc basis to forecasts of quarterly growth rates.

**11. The Inflation Dashboard now provides a fixed and coherent system for building CPI-forecasts bottom-up.** The system starts with monthly seasonally adjusted forecasts from NTF-models of level indices for core, food, and energy inflation. Judgement can be added on a month-by-month basis to the three groups. Forecasts including judgement are then aggregated to a forecast for headline CPI and quarterly indices and growth rates are constructed for the policy model.

**12. The Inflation Dashboard is highly automated and easy to update between forecast rounds.** It provides the inflation team with a forecast on a monthly frequency, thus allowing for real time monitoring of monthly inflation outcomes relative to forecasts. The system could in this way be used for assessing the effect on previous MPR forecasts of new data and updated NTF forecasts. Previously, the inflation team has had to wait for the end of quarter to assess how forecasts have fared relative to the actual inflation outcome. Going forward, the inflation team should update NTFs and the Inflation Dashboard with every new inflation outcome.

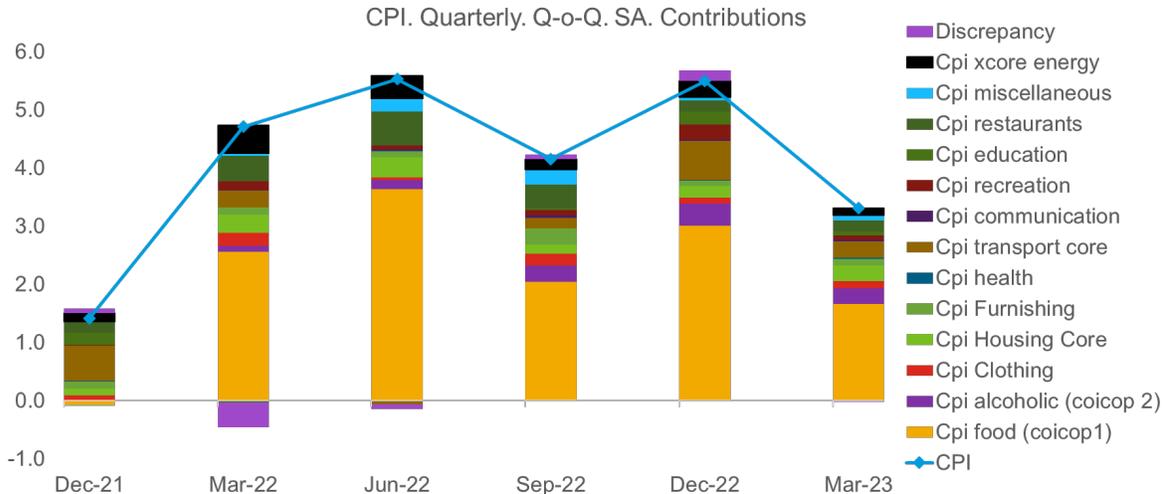
**13. The mission extended the NTF-system to forecast the twelve main COICOP CPI groups.** NTF-forecasts are added to the Inflation Dashboard and inherit judgement applied to either core, food, or energy. In this way, the Dashboard provides a much more detailed view of disaggregate contributions to the overall CPI forecast than previously available (see Figure 1). This is highly important in gaining a deeper understanding of what is driving inflation in the forecasts and which sub-groups are contributing to forecast errors. In due course, the inflation team should move from making CPI forecasts for core, food, and energy directly, to

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<sup>5</sup> Classification of individual consumption by purpose (COICOP).

forecasting these three groups from bottom-up using the extensions developed at this mission.

Figure 1. From Inflation Dashboard—Contribution to Headline CPI Inflation Outcomes and Forecasts (Quarterly Percentage Change)



**14. The mission also amended the import function of the CPI-NTF-system to improve data management on daily frequency (mostly exchange rates and commodity prices).** Previously, all input data has been on quarterly frequency. Going forward, the inflation team should be diligent in always updating all high frequency data before running the NTF-system.

**15. The mission developed a framework for conducting regular forecast error analysis and conducted such an analysis based on the evaluation period of 2018 Q3 (the earliest available forecasts) to 2022 Q3.** The forecast error analysis showed that forecasts for headline CPI and sub-groups have been unbiased (average error = 0), and that forecast accuracy has been good (RMSE lower than standard deviation of data, see Figure 2). The inflation team should continue using and updating the framework and should also extend it to the forecasts on a monthly frequency. Due to data availability the current system uses data on quarterly frequency.

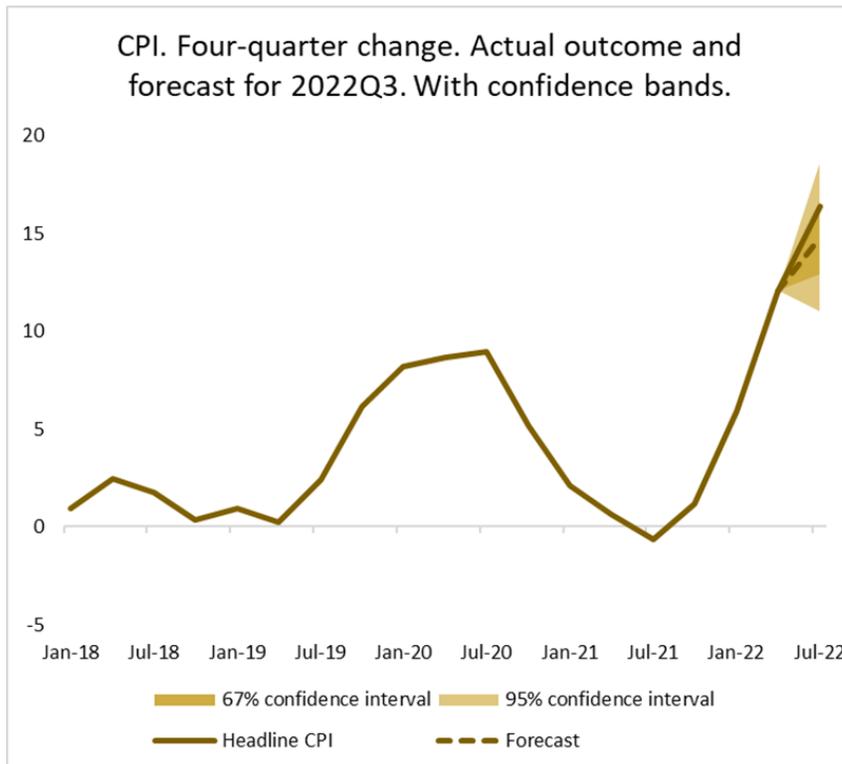
**16. The output from the inflation forecast analysis was used for producing measures of forecast uncertainty, so called confidence bands (see Figure 3).** The mission developed easy-to-use tools for constructing and updating related charts. These charts are useful in communicating a frame of reference to the Monetary Policy Committee (MPC) for evaluating uncertainty surrounding forecasts and inflation outcomes. The NBR team expressed their concern that the uncertainty bands are based on a small sample. While this concern is valid, the main point of the exercise was to show how such bands can be generated and used to communicate forecast performance over time and uncertainty surrounding current forecasts. Furthermore, the NBR expressed concerns that MPC may be confused by

introducing confidence bands that are not in line with the confidence bands from the QPM model. Confidence bands from the QPM is a separate issue and shows model uncertainty from that system.

Figure 2. Results from Forecast Error Analysis

Forecast Error Analysis				
	Headline	Core	Food	Energy
Observations	17	16	16	16
Mean forecast error	-0.3	0.0	-0.9	-0.1
T-statistic of mean error	-0.6	0.0	-1.1	-0.2
P-value of mean error	0.56	0.98	0.30	0.87
Contribution to headline mean error	-	0.0	-0.3	0.0
Mean absolute forecast error	1.6	1.3	2.6	2.6
Mean square error	3.5	2.3	10.6	8.5
Root mean square error	1.9	1.5	3.3	2.9
Normalised RMSE	0.4	0.6	0.4	0.4

Figure 3. Example of Uncertainty Bands



**17. The mission also expanded the variables analyzed in the inflation outcome system and trained NBR staff on how to use the system.** The output from the inflation outcome system was refined to produce higher quality graphs used for external and internal

communication. Previously, graphs have been copied from the system and pasted directly into the MPRs. This has been at odds with the layout and image quality of the MPRs. The mission also resolved some existing issues with the domestic database (such as duplicate data and incorrect weights). Outputs from all tools developed in this mission were added to a template of nowcasting presentations for the forecast meetings.

All tools developed during this TA mission as well as the previous missions should be used on a monthly basis to assess the new outcomes of inflation.

Figure 4. Important Tools for Inflation Outcome Analysis and Forecasts at the NBR

Name	What	Purpose	Create
Inflation Outcome	Collection of eviews programs	Charts and data on disaggregated inflation and december 100 indices. Computes measures of underlying inflation	Sep 21 (refined Mar and Dec 22)
Near term forecasting system	Collection of eviews programs	Forecast inflation for QPM core, food and xcore energy + 12 coicop groups. Pseudo-real time. Forecasting averaging based on RMSE.	Mar 22 and Dec 22
Inflation Dashboard	Excel (highly automated)	Aggregates forecasts for CPI based on NTF and judgement on QPM core, food and xcore energy. Automatically applies judgement to forecasts for 12 coicop groups from NTF.	Dec 22
Forecast outcome	Excel (highly automated)	Computes forecast errors and statistics for forecast error analysis. Decomposition of forecast errors.	Dec 22
Fan Charts	Excel (highly automated)	Create fan charts based on RMSE	Dec 22

## B. The Nowcasting System for GDP

This mission continued refining the nowcasting system that was developed during the March 2022 mission.

**18. The nowcasting framework at the NBR prior to the March mission included some bridge equations based on domestic explanatory variables and a Dynamic Factor Model (DFM), all used to “backcast” (forecast of the previous quarter outcome) an estimated monthly GDP variable (quarterly GDP divided by 3). The framework did not include out of sample evaluations of the forecast and were all based on annual changes. Hence, this framework displayed some inherent shortcomings.**

**19. The FPAS mission in March started to build an E-views-based system for GDP nowcasting, similar to the one developed for CPI.** The new system aims to be more transparent to provide support for judgement and storytelling. It consists of simple bivariate bridge equations with indicators that have proven to perform well in out-of-sample forecasting. The system makes both a backcast and a nowcast for the previous and current quarter, based on a model averaging. This system outperforms a simple benchmark auto regressive model for both the one and two quarter horizons.

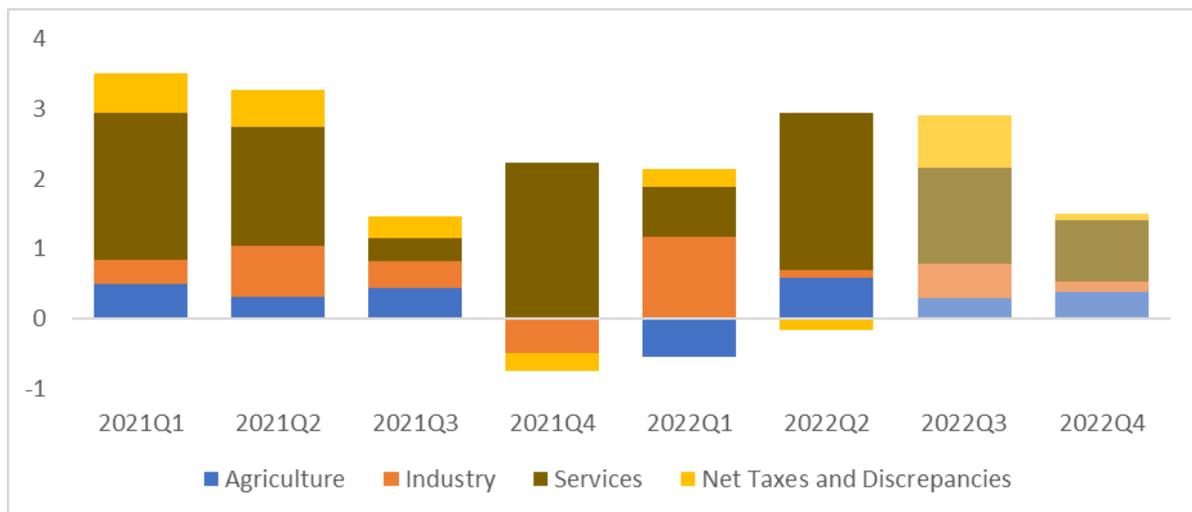
**20. The nowcasting system for GDP developed in March has not yet been used in the NBR, due to difficulties with updating the external variables that entered in the system.**

This shows the importance of organizing and updating the external data in a more systematic way. The new external database makes this process easier.

**21. This mission in December 2022 focused on refining the nowcasting system developed in March, and on establishing a good understanding of the system in the GDP nowcasting team.** It extended the NTF-system, by providing disaggregate forecasts for the main sectors (Agriculture, Industry, Services and Net Taxes). The disaggregate GDP nowcasts complements the aggregate nowcasts developed in March and helps providing a story behind the nowcast, see Figure 5.

Figure 5. Contributions to GDP Growth from Different Sectors.

*Shaded Bars Show Forecasts from the NTF-System (Quarterly Percentage Change)*



**22. The new NTF system for GDP now consists of:**

- 1) An *aggregate approach*, where several bridge equations forecast aggregate GDP directly. A weighted average of all the forecasts from the bridge equations is then computed, where the weight is based on the model's historical forecasting performance. A different set of bridge equations are used for the two horizons.
- 2) A *two-sector approach*, where output in the Agricultural sector and the Non-Agricultural sector is forecasted separately, using the same framework as the aggregate approach, with bridge equations and model averaging.
- 3) A *four-sector approach*, where output in the main sectors (Agriculture, Industry, Services and Net Taxes) are forecasted separately, using the same framework as described above.

**23. The system for summarizing the nowcasts from the different approaches (aggregate and disaggregate) was built in excel (the GDP forecast spreadsheet).** This spreadsheet makes it easy for the sector experts to add judgement to the quarterly growth

rates in different sectors, and to compare the final nowcasts to both historical outcomes and nowcasts from the models.

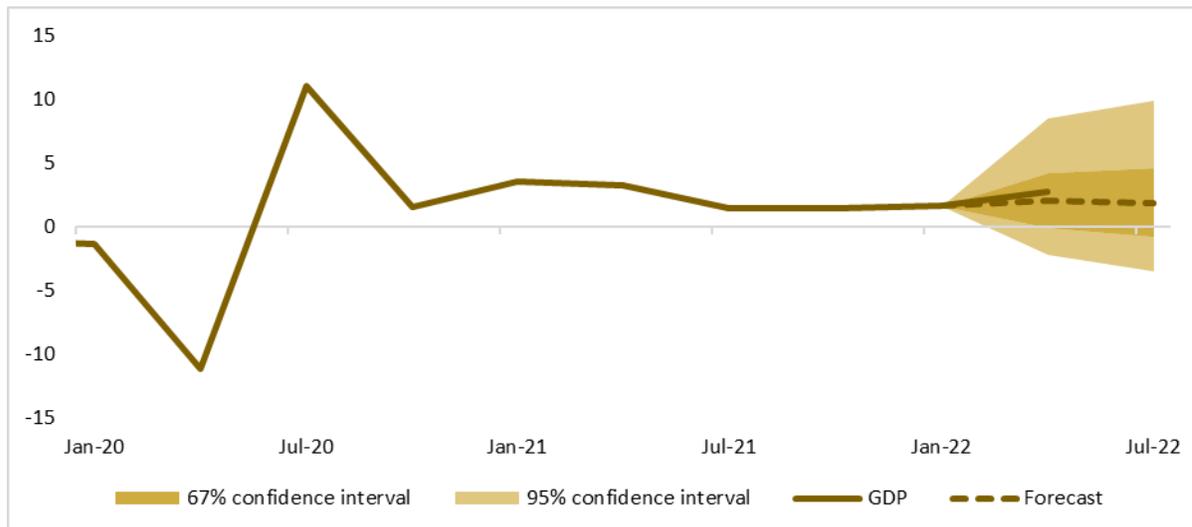
**24. The mission also conducted a forecast error analysis of all three approaches in the new system, as well as the DFM model.** The analysis shows that the new system outperforms both the DFM model and a simple autoregressive benchmark (AR1) (see Table 2). The analysis reported here is based on an evaluation sample from 2019Q1 to 2022Q2, but the results hold also if we extend the sample back to 2015Q1.

**Table 2. Forecasting Performance (RMSE) from the Different Approaches**  
(Evaluation Sample: 2019Q1-2022Q2)

	RMSE: Horizon 1	RMSE: Horizon 2
Four-sector approach	2.7	4.1
Two-sector approach	2.6	3.1
Aggregate	2.7	3.3
DFM (old system)	6.2	
AR1	6.4	7.4

**25. The output from the GDP forecast analysis was used for producing confidence bands around the GDP forecasts, in the same way as for CPI inflation (Figure 6).** The charts could be very useful both in illustrating the uncertainty surrounding the forecasts, and for assessing whether recent outcomes are very different from the previous nowcast.

Figure 6. Example of Uncertainty Bands for GDP



**26. The mission also revisited the system for analyzing GDP outcomes developed in March 2022 mission.** When analyzing real sector outcomes, it is important to focus on seasonally adjusted quarterly growth rates, rather than annual changes. Current developments

are easily missed when looking at annual changes, as the contributions depict the yearly cumulated contribution to growth in a specific quarter making them very difficult to interpret.

**27. The tools for analyzing GDP outcomes and providing nowcasts for GDP developed during this and the previous mission are summarized in Figure 7.** These tools should be used on a regular basis for analyzing new GDP outcomes and providing updated nowcasts as new data becomes available.

Figure 7. Important Tools for GDP Outcome Analysis and Forecasts at the NBR

Name	What	Purpose	Created
GDP Outcome	Collection of eviws programs	Charts on contributions to GDP growth from different sectors.	Mar 22
Near term forecasting system	Collection of eviws programs	Forecast GDP and different sectors of GDP. Pseudo-real time. Forecasting averaging based on MSE.	Mar 22 and Dec 22
GDP Forecast Dashboard	Excel (highly automated)	Builds forecasts for GDP and the different sectors based on NTF and judgement.	Dec 22
Fan Charts	Excel (highly automated)	Create fan charts based on RMSE	Dec 22

### III. EXTERNAL ASSUMPTIONS

**28. Previous missions have identified problems with the existing system for constructing external assumptions for the policy models.** The problems at times have had significant effects on the dynamics in the model, and hence on the policy recommendations. The mission started the work of establishing a new system for external assumptions by streamlining the setup of external databases. The mission suggests moving towards a system of using Macro Bond/Bloomberg consensus forecasts in combination with staff judgement.

#### A. Existing System for External Assumptions

**29. The existing system for external forecasts uses MATLAB drivers to automatically link historical data to forecasts and transform data to quarterly frequency for the policy models.** The forecasts are collected from external sources, such as the US Congressional Budget Office (CBO).

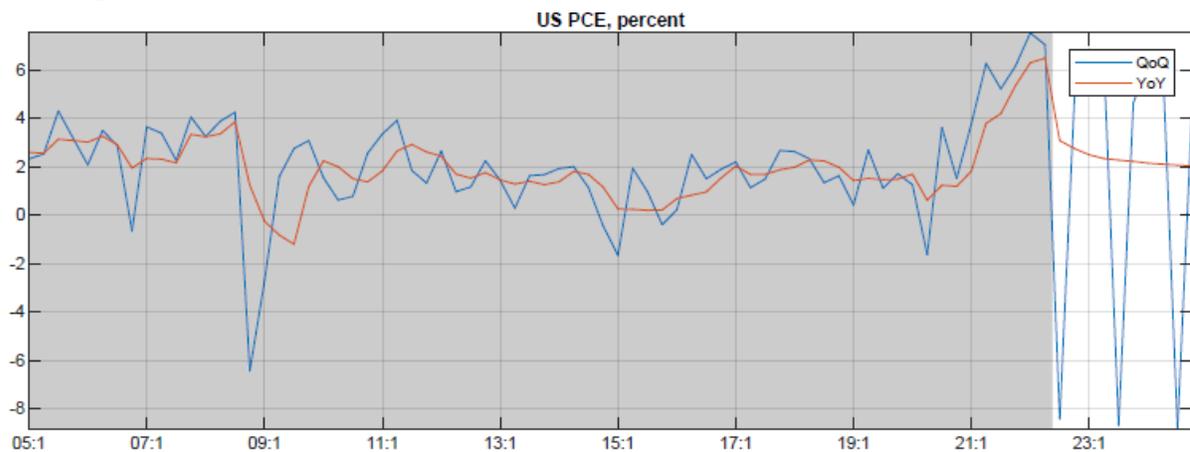
**30. There is a problem with using outdated forecasts for external assumptions.** The problem arises partly because the out-of-date external projections are linked to up-to-date historical data<sup>6</sup> and partly because data series on different growth rates and frequencies are linked together. For example, in the November 2022 MPR, up-to-date data for US PCE were linked to CBO forecasts for year-over-year inflation made in May 2022. At this time, actual US inflation was much higher than forecasted by the CBO in May.

<sup>6</sup> According to the NBR, the problem related to outdated external projections has been resolved since the mission and the NBR has a subscription to the macro bond database.

**31. To produce data on a quarterly frequency for the policy model, the MATLAB driver is used for backing out a quarterly growth rate that is consistent with both the historical data and the y-o-y forecasts.** In the current example, this means that inflation going forward had to be unrealistically low, see Figure 8. To match the outdated y-o-y forecasts, this leads to a very strange pattern for q-o-q inflation going forward.

**32. The same kind of problems also affect forecasts for GDP and commodity prices** (where forecast on annual frequency is linked to historical data on monthly frequency).

Figure 8. External Assumptions for US PCE Inflation in the November MPR



## B. New External Database

**33. The mission started the work of establishing a new system for external assumptions by streamlining the set-up of external databases.** Previously, external database and forecasts have been stored in three main databases (US, euro area, and world food prices) and several ad hoc databases. The partitions between the databases have not been very clear. For example, prices and oil price forecasts have been stored in the euro area database.

**34. The updated set up consists of one database for historical external data (mirroring the domestic database) and one database for external forecasts.** The new set up is easier to navigate and provides a better overview of available data. The procedure for updating data has been made simpler and more robust. The new set up is also easier to access for CPI and GDP NTF-systems.

## C. Proposal of A New System for External Assumptions

**35. The mission started looking into how to establish a simple, robust, and efficient process for forecasting external variables that go into the policy model.** Currently, the external assumptions are produced mechanically. According to the NBR, the forecasting team would analyze the data and include judgment, when necessary, but sometimes errors in

the codes may go unnoticed. The mission proposed that at least two persons should be in charge of the new system, and actually oversee the process of linking historical data to forecasts and keep track of external developments and their impacts on the forecasts.<sup>7</sup>

**36. Due to human resources restrictions, it would be more efficient to have a new system for external assumptions that is based on using forecasts directly from external providers instead of making in-house forecasts.** The forecasts should be collected from more up-to-date sources than what is currently done. It is the mission's conclusion that at the current stage, using outside providers for external assumptions is more efficient than using in house forecasting. The NBR forecast team already is busy with forecasting domestic developments and needs to advance further and master on how to do that before moving on to forecasting external developments. In general, a small central bank should not devote large resources to forecasting in detail developments abroad. For example, the Norwegian central bank also bases its external forecasts heavily on private sector forecasts. Specifically, the mission proposed that forecasts for GDP and inflation (US and euro area) should be based on up-to-date forecasts from Bloomberg Consensus. These forecasts are, in principle, updated daily. The external assumptions team should also be sufficiently confident on external developments to be able to add judgement to the forecasts if needed. The workload of such a system should be relatively light, but for robustness, at least two persons should be knowledgeable in how to update the external assumptions.<sup>8</sup>

**37. As regards to forecasts for the remaining variables, forecasts should be based on financial market variables as indicated in Figure 9.** When building a new system care needs to be taken to make sure that there are no unintended effects in the functioning of the policy model.

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<sup>7</sup> According to an update from the authorities. the BNR has started work on developing a new internal data base since this TA. The setting up of the data science team is at its final stage.

<sup>8</sup> As regards costs, Consensus forecasts are already provided free-of-charge through the Bloomberg terminal. NBR is already paying for Bloomberg and the mission assumes consensus forecasts are also free-of-charge in Macro Bonds.

Figure 9. External Assumptions for US PCE Inflation in the November MPR

Variable	Current system	Proposal for new system
GDP and inflation (US and EMU)	Forecasts on quarterly frequency from CBO and ECB. Very infrequent updates	Use Bloomberg Consensus forecasts (in principle updated on daily basis)
Federal Funds Rate	Forecasts on quarterly frequency from CBO. Very infrequent updates	Use OIS-rates (market prices).
USD/EUR	Forecasts on annual frequency from ECB. Very infrequent updates. Difficult to transform to quarterly frequency	Use forward prices. (= covered interest rate parity)
Oil price	Forecasts on annual frequency from IMF. Very infrequent updates	Use forward prices.
World food prices	Forecasts on annual frequency from WB. Very infrequent updates	Use high frequency (daily) data and forecast with Random Walk (?)

#### IV. ENHANCING COMMUNICATION TOOLS

**38. This mission also developed presentation templates for the nowcasting meetings both for CPI inflation and GDP.** The templates analyze recent outcomes, focusing on contributions from different sectors of GDP or subgroups of CPI. Recent outcomes are compared with the previous nowcast and gives an explanation to the deviation between the outcome and the nowcast. Since the new system provides nowcasts on different sectors of GDP and subgroups of CPI, it is much easier to tell a story behind the forecast error.<sup>9</sup>

**39. The template presents recent developments in the most important indicators, focusing again on developments in different sectors.** Finally, it presents updated nowcasts, showing both model nowcasts and the judgement from the sector experts. Future missions should assist the NBR team in the continued development of more informative nowcasting presentations for the forecast meetings based on the outputs from the new nowcasting framework for CPI and GDP.

**40. Future missions should work together with the NBR team to develop templates for internal memos presenting recent outcomes both for GDP and CPI inflation.** These memos should include outputs from the tools developed during this and previous missions, along with information on how the forecast fares against new outcomes. Such memos are quite standard at leading central banks and normally circulated a few hours after new CPI or GDP outcomes have been published by the national bureau of statistics (NBS).

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<sup>9</sup> After the mission, the NBR staff informed the mission that analysis on outcomes relative to forecasts can be added to existing inflation briefs, and that they will not be requiring assistance in developing this product. Until then, the mission was not briefed on the existence of the internal memos.

## V. NEXT STEPS

- 41. The nowcasting framework should continue to be refined and improved to support deeper monetary policy analysis.** The framework based on a disaggregated level will help facilitate a better understanding of economic developments and more effective policy communication with a better storytelling. It was agreed that the next TA mission should be preferably in person.
- 42. The new CPI and GDP NTF tools should be used on a monthly basis as part of the forecasting process and FPAS work at the NBR going forward.** The new CPI NTF system includes the monthly forecasts of ten subgroups of the core CPI inflation as well as two subgroups of food inflation, thus enabling the assessment of the key drivers of the inflation as well as the nature of inflation shocks. It also allows for the “real time” monitoring of monthly inflation outcomes relative to the forecast. Similarly, the new GDP NTF-system focuses on forecasting production in the different sectors and significantly improves the forecasting results. It should replace the current dynamic factor model (DFM). The analysis based on these new NTF systems would provide crucial input for the nowcast and the nowcast meeting during the forecast process. Staff should prepare a manual for the new tools and the new measures on underlying inflation.<sup>10</sup> Moreover, NBR should continue work on establishing a simple, robust, and efficient system for producing external assumption forecasts for the policy model. The system should be managed by at least two persons, be based on forecasts from outside providers (such as Macro Bonds/Bloomberg consensus), and allow for efficient monitoring of external developments. Finally, there need to be more permanent staff working on the FPAS.
- 43. In addition, additional IMF TA could be helpful to continue assisting the NBR in strengthening the monetary policy process, better aligning the forecast and decision-making process with the text (communication) process.** The latter should also form part of broader TA on communications. Appendix IV (FPAS TA log frame for Rwanda) presents more general recommendations and the details of the FPAS project.

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<sup>10</sup> The NBR’s “Explanatory Note on the Indicators of Underlying Inflation in Rwanda”, which the TA team received after the mission, describes different ways of measuring inflation in Rwanda (headline, core, trimmed mean, etc.).

**APPENDIX I. PRESENTATION FOR THE CONCLUDING SESSION**



Adobe Acrobat  
Document

**APPENDIX II. USER GUIDE TO THE CPI NOWCASTING SYSTEM**

[Rwanda FPAS 2022 - OneDrive \(sharepoint.com\)](#)

**APPENDIX III. DESCRIPTION OF THE GDP NOWCASTING SYSTEM**

[Description of the GDP NTF system.docx](#) (SharePoint)

#### APPENDIX IV. THE FPAS LOGFRAME FOR RWANDA

Objective: Improve the analytical and forecasting capabilities for monetary policy decision-making – MAF			
Outcome: FPAS fully integrated into the monetary policy decision-making process.			
Annual Assessment Rating: 2 Partially Achieved			
Outcome Rating Date: 12/21/2022			
Outcome Indicator	Baseline Value	Target Value	Current Assessment Value
A structured forecasting process and schedule is in place with specified responsibilities.	A basic forecast process has been developed but roles and responsibilities are unclear	A fully fledged forecast process has been established with clear roles and responsibilities	Partially achieved as of 12/21/2022
Analytical reports are published routinely on the same frequency.	A monetary policy report is published regularly	The monetary policy report is characterized by a clear economic story and clear policy arguments	Largely achieved as of 12/21/2022
Forecasting team presents macroeconomic developments and forecast report to the monetary policy committee (MPC).	FT presents baseline forecast to the MPC	Presentations to MPC has been elaborated with a clearer story and includes scenarios	Largely achieved as of 12/21/2022
MPC understands the structure of the core QPM and the underlying FPAS mechanisms.	The FPAS including its tools and models are still new to the MPC	The MPC has experience and exposure to the FPAS and all its key components	Partially achieved as of 12/21/2022
MPC uses staff projections in their policy decision making.	MPC regularly deviates from staff recommended policy without changes to the forecast	Forecast and policy decisions are consistent and aligned with the MPCs views	Partially achieved as of 12/21/2022

Regular interactions between MPC and FT take place according to the forecast calendar.	Forecast calendar is not aligned with important data releases and interactions with the MPC are not timely nor very interactive	Forecast calendar is pre-set, fixed, and aligned with important data releases. Interactions between FT and MPC are interactive and inform the final forecast	Partially achieved as of 12/21/2022
<b>Milestone Name</b>	<b>Target Completion Date</b>	<b>Milestone Actual Completion Date</b>	<b>Milestone Rating</b>
The forecast schedule for each policy round is adjusted for important data releases and ensures adequate time to derive the forecast in a stepwise manner.	4/30/2022		2 Partially Achieved as of 12/21/2022
The monetary policy meeting schedule is set and published half a year in advance taking into account important events, public holidays, data releases, etc.	4/28/2023		1 Not Achieved as of 12/21/2022
The forecast process in place includes regular interaction between policy makers and staff responsible for policy analysis	4/30/2023		2 Partially Achieved as of 12/21/2022
The forecast process facilitates for coordination between divisions and departments facilitating for a fully informed and thoroughly discussed forecast.	4/30/2023		2 Partially Achieved as of 12/21/2022
Staff present and clearly explain model-based policy scenarios, recommendations, tradeoffs, and alternatives at policy meetings.	4/30/2023		2 Partially Achieved as of 12/21/2022
The NBR publishes a report after each monetary policy meeting which clearly explains and illustrates the forecast, the risks to the forecast and the motivation for the MP decision.	4/30/2023		3 Largely Achieved as of 12/21/2022
The NBRs monetary policy communication has an established practice of a press conference and a press release following international best practice	4/30/2023		
Roles of modeling, forecasting, other types of economic analysis, and judgment in informing monetary policy decisions are defined and documented.	4/30/2024		2 Partially Achieved as of 12/21/2022

The NBR has developed a monetary policy communication policy and strategy that governs the internal and external monetary policy communication	4/30/2024		
<b>Outcome: Improved economic analysis and forecasting capabilities at the CB.</b>			
<b>Annual Assessment Rating: 2 Partially Achieved</b>			
<b>Outcome Rating Date: 11/22/2021</b>			
<b>Outcome Indicator</b>	<b>Baseline Value</b>	<b>Target Value</b>	<b>Current Assessment Value</b>
A forecasting team is set up and integrated in the decision-making process.	Sector experts are not fully integrated in the forecasting team and clear processes for how to inform the forecast with judgment is lacking.	Sector Expert capacity is developed and integrated in the forecast process with clear sector expert roles and responsibilities.	Largely Achieved as of 12/21/2022
A near term forecasting toolkit is operational, used in the regular forecasting exercise rounds, and regularly updated.	Some NTF tools and models are used	A suite of NTF and nowcasting models for key variables have been developed and used	Largely achieved as of 12/21/2022
A quarterly projection model is operational, used in the regular forecasting exercise rounds, and regularly updated for medium-term forecasting.	A basic QPM has been developed and used for forecasting	The QPM has been enhanced and used efficiently for both baseline and scenario forecasts	Largely achieved as of 12/21/2022
<b>Milestone Name</b>	<b>Target Completion Date</b>	<b>Milestone Actual Completion Date</b>	<b>Milestone Rating</b>
Sector Expert capacity is being developed, and starting to be integrated in the forecast process with clearer sector expert roles and responsibilities	4/30/2022		2 Partially Achieved as of 12/21/2022
Judgement, model based NTFs, and error analysis of forecasts are clearly presented and used to inform the near-term forecasts.	4/30/2023		2 Partially Achieved as of 12/21/2022

Staff are comfortable developing scenario analysis and policy simulations and presenting it to the MPC	4/30/2023		2 Partially Achieved as of 12/21/2022
A suite of near-term forecasting tools and models that cover key variables have been developed	4/30/2023		3 Largely Achieved as of 12/21/2022
Benchmark QPM has been extended with relevant additional blocks	4/30/2024		3 Largely Achieved as of 12/21/2022
Near-term forecasting toolkit documentation developed, including manuals and model, tool, and indicator descriptions	4/30/2024		2 Partially Achieved as of 12/21/2022
Benchmark QPM forecasts are complemented with labor market analysis (no time series data available yet).	4/30/2025		1 Not Achieved as of 12/21/2022