



TECHNICAL ASSISTANCE REPORT

TONGA

Macroeconomic Frameworks Technical Assistance (TA) on Developing a Forecasting and Policy Analysis System (FPAS) at the National Reserve Bank of Tonga (NRBT)

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Table of Contents

Acronyms and Abbreviations	2
Preface	3
Executive Summary	4
Section I. Overview of the NRBT FPAS TA Project	5
A. Role of forecasting/nowcasting and FPAS in conducting forward-looking monetary policy	5
B. Objectives of the NRBT Macroeconomic Frameworks FPAS TA Project	6
C. Developing analytical tools and building technical capacity	7
D. Integration of tools into internal processes and external communications	8
Section II. Overview of TA missions	10
A. Mission 1: November 2021 (virtual)	10
B. Mission 2: May 2022 (virtual)	10
C. Mission 3: July 2022 (virtual)	10
D. Mission 4: October 2022 (virtual)	11
E. Mission 5: November 2022 (virtual)	11
F. Mission 6: February 2023 (in-person)	11
G. Mission 7: September 2023 (virtual)	12
H. Mission 8: November 2023 (in-person)	12
I. Mission 9: January 2024 (in-person)	12
J. Mission 10: June 2024 (in-person)	13
K. Mission 11: January 2025 (in person)	13
Section III. Working Paper Outputs	15
A. IMF Working Paper WP/23/153	15
B. Forthcoming working paper	15
Section IV. Aide-Mémoire (Post January 2025 Mission)	17
Section V. References	18

Acronyms and Abbreviations

FPAS	Forecasting and Policy Analysis System
ICD	Institute for Capacity Development
IMF	International Monetary Fund
JSA	Japanese Sub-Account funding
NRBT.....	National Reserve Bank of Tonga
NTF	Near-Term Forecast
QPM	Quarterly Projection Model
TA.....	Technical Assistance
WP.....	Working Paper

Preface

At the request of the National Reserve Bank of Tonga (NRBT), a Macroeconomic Frameworks Technical Assistance (TA) Project on developing a Forecasting and Policy Analysis System (FPAS) for NRBT was conducted by ICD during 2021-25.

A total of eleven missions (five in-person and six virtual) were conducted during 2021-25. The project focused on two broad and complementary workstreams, both with noteworthy achievements but also some room for improvement:

- i. Developing analytical tools for macroeconomic assessment and forecasting among NRBT staff
- ii. Integration of the resulting analytical reports into NRBT's policy processes and external communications.

The FPAS TA project has largely achieved its objectives: NRBT forecasting team has made remarkable progress and is regularly delivering high-level analytical support to the policymakers. FPAS-based work now plays a key role in the NRBT policy processes and its forward-looking monetary policy formulation.

The mission team consisted of Celine Rochon (ICDFP, Project manager, who participated in all TA missions) and Sam Ouliaris (short-term expert, who participated in all TA missions and reviewed this TA report). During the in-person missions, the TA team met regularly with the Governor Mr. Tatafu Moeaki and the Assistant Governor for Policy, Mr. Daniel Taumoepeau.

The mission team would like to express its appreciation to NRBT management and staff for their very warm hospitality and excellent cooperation throughout the TA Project lifecycle. The mission team also acknowledges the generous support of the Government of Japan under the Japanese Sub-Account (JSA) funding.

Executive Summary

The multi-year NRBT Macroeconomic Frameworks FPAS TA Project focused on building new institutional capacity for model-based forecasting and policy analysis, along with its integration into monetary policy processes and external communications. Following a scoping mission in November 2021, a total of ten missions (five in-person and five virtual) were conducted. The FPAS TA project has largely achieved its objectives.

The NRBT forecasting team has made remarkable progress and is currently delivering high-level analytical support to the policymakers. Staff have built a strong skillset and expanded the relevant knowledge base. They now can use a rich suite of analytical tools to implement the internal forecast calendar and follow all the necessary steps to prepare model-based results and forecasts for key macroeconomic variables. Operational use of the core Quarterly Projections Model (QPM) in producing baseline forecasts, alternative scenarios, using expert judgements, assembling the forecast narrative and delivery to peers is performed efficiently and following best central bank practice.

Analytical work plays a key role in the NRBT policy processes and its forward-looking monetary policy formulation. Model-based results are communicated directly to the Governor. Forecasts feature, to some extent in external communications, including Monetary Policy Reports.

Recommendations relate mostly to ensuring the tools are used regularly and steady progress continues to be achieved following the TA project. Macroeconomic, organizational, and capacity challenges still need to be addressed, related to changes to the team composition, and weak data sharing across ministries. The NRBT forecasting team would benefit from being further expanded and having more time to practice model building and fine-tuning. Given the heavy workload and the complexity of transferring and expanding the model-based analytical skills among newest staff, the team is still too small to sustainably operate a fully integrated, modern FPAS. A larger forecasting team will ensure FPAS continuity, including further development and enhancement of the modeling tools. Avoiding capacity losses due to staff turnover, as has happened in the past, is key to FPAS self-sustainability. Also, a larger team would further enhance the analytical support to NRBT policymaking by responding more efficiently to policy requests and will allow the unique skills and comparative advantage of the forecasting team to be used more productively. Further improvement with the development and communication of alternative scenarios could play a more prominent role in the current shock-prone environment, but this requires time and resources invested by the team.

External communications could be further streamlined, to help further anchor market expectations, improve transparency, and build institutional credibility in supporting the forward-looking approach to policymaking.

Section I. Overview of the NRBT FPAS TA Project

1. The National Reserve Bank of Tonga (NRBT) requested technical assistance (TA) from ICD in April 2021 to develop a Forecasting and Policy Analysis System (FPAS) to modernize its monetary policy framework. In response to NRBT's request, ICD agreed to conduct a multi-year Macroeconomic Frameworks TA project focused on the development of a Forecasting and Policy Analysis System (FPAS) to support the modernization of the NRBT's monetary policy framework. The project aimed to improve economic analysis and forecasting capabilities at NRBT, streamline the decision-making process, and strengthen the forward-looking monetary policy communication strategy at the Reserve Bank. The initial timeline of the TA project was adversely impacted by the pandemic crisis and associated travel restrictions, with TA delivery being conducted virtually. In total, ICD delivered ten TA missions (five remotely, and five in-person), to ensure continuous capacity building activities and integration of analytical results into policy processes, in support of the NRBT conduct of a forward-looking monetary policy.

2. Tonga, like most Pacific Island states, has a weak monetary policy transmission mechanism.

Due to an underdeveloped financial market and persistent excess liquidity in the banking system, the interest rate channel of monetary policy is ineffective. For this reason, the National Reserve Bank of Tonga (NRBT) – Tonga's central bank – has relied more heavily on the exchange rate channel to achieve its monetary policy objectives. The primary objectives of the NRBT are (a) to maintain internal price stability by keeping inflation below a reference rate (currently of 5 percent), and (b) maintain an adequate level of foreign reserves of a minimum of 3 months (and optimally around 7.5 months) of imports. The exchange rate regime serves as the nominal anchor. Though the Tongan Pa'anga is pegged to a basket of currencies, the NRBT has the flexibility to adjust the exchange rates by 5 percent each month if necessary to achieve its objectives and address any misalignment with fundamentals. As the interest rate channel for monetary policy is ineffective, the NRBT also employs capital controls to protect its peg and maintain the level of foreign reserves above the minimum cover.

3. Tonga is an import dependent country with its trade deficit averaging about 50 percent of GDP in the past decade. This large deficit is funded through remittances (which are around 40 percent of GDP) and budget support. As such, Tonga is highly vulnerable to developments in the global economy and especially its main trading partners.

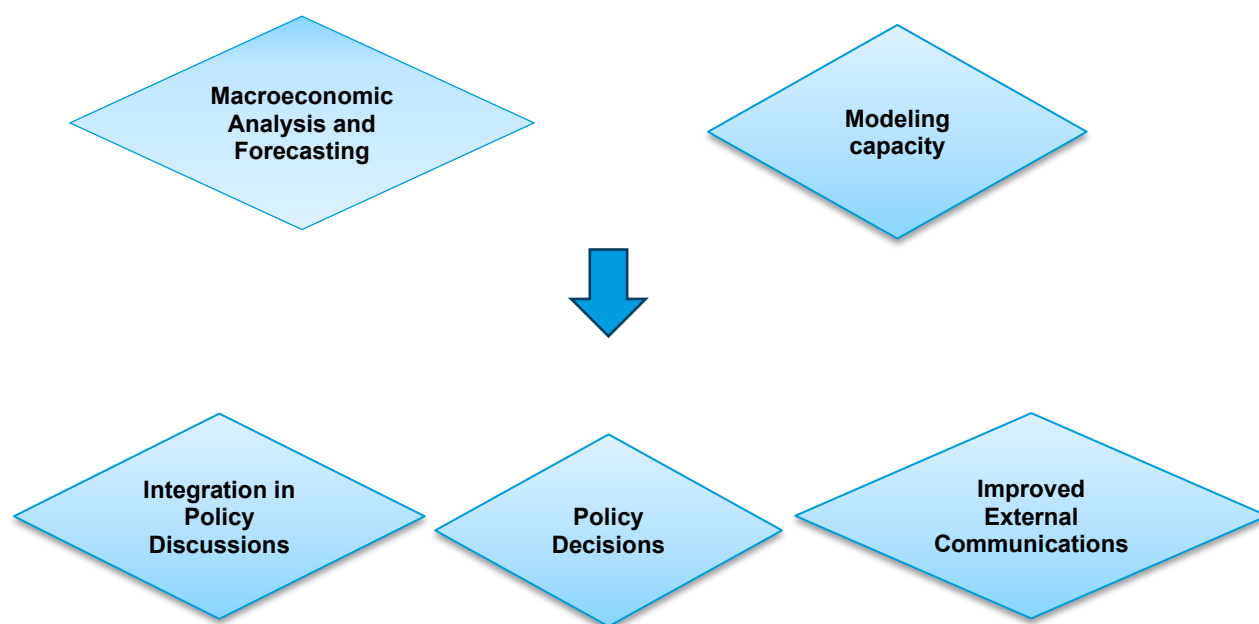
A. ROLE OF FORECASTING/NOWCASTING AND FPAS IN CONDUCTING FORWARD-LOOKING MONETARY POLICY

4. Modern central bank practice recognizes the benefits of a forward-looking approach to policymaking. This accounts for the transmission lags and impact of agents' expectations when deciding on the future trajectory of the policy instruments consistent with achieving primary objectives (e.g., in the case of NRBT, the main policy instrument is the exchange rate, and the reference rate of inflation is 5 percent). A well-developed analytical toolkit is key to providing valuable support to the decision-making process.

5. In this context, central banks develop and apply a Forecasting and Policy Analysis System (FPAS) – a set of tools and processes that provide analytical support to the policy making

process. The multi-year NRBT Macroeconomic Frameworks FPAS TA project's main objectives were to build new institutional capacity for model-based forecasting and policy analysis, along with its integration into monetary policy processes and streamlined external communications. The missions first centered on developing macroeconomic analysis and forecasting/nowcasting capacity, to prepare NRBT staff to master modeling tools, particularly the Quarterly Projection Model (QPM), which is the main tool to provide real-time analytical support to policy making (Figure 1).

Figure 1: NRBT FPAS TA Project workstreams



B. OBJECTIVES OF THE NRBT MACROECONOMIC FRAMEWORKS FPAS TA PROJECT

6. The TA Project has largely achieved its building capacity objective and the incorporation of FPAS work into policy-making processes and external communications. The outcome indicators and milestones of the project are detailed in the Results-Based Management framework, used for regular monitoring and reporting of the project progression, and broadly presented in Figure 2.

Figure 2: FPAS TA Project outcome indicators and milestones

Objectives	Outcomes	Outcome indicator/Milestone description
Building capacity	Improved economic analysis and forecasting capabilities at NRBT	1.1. Deliver customized MFA course, including hands-on workshops using Tonga data 1.2 Deliver customized Nowcasting course, including hands-on workshops using Tonga data 1.3 Deliver customized MDS / Macroeconomic Frameworks training
Analytical models and forecasting tools are developed and operational	A. Fully operational suite of forecasting and nowcasting models and tools are developed	1.4 Develop and extend the nowcasting modeling toolkit 1.5 Catalogue and save the available Tongan time series data in EViews
	B. A Canonical Quarterly Projection Model (QPM) for Tonga is developed	1.6 Calibration and construction of the QPM for Tonga 1.7 Advanced scenario analysis using the QPM for Tonga

7. The building of forecasting/nowcasting and modeling capacity, with the goal to produce relevant forward-looking analysis and policy recommendations, consisted of several workstreams. These included developing the skillset of staff in the Economics Department; developing efficient data management procedures; establishing nowcasting, near-term forecasting (NTF) and other satellite tools; and developing the QPM to produce medium-term forward-looking analysis.

C. DEVELOPING ANALYTICAL TOOLS AND BUILDING TECHNICAL CAPACITY

8. The analytical toolkit underlying the NRBT's FPAS was enriched and extended throughout the TA project. The broad suite of analytical instruments comprises empirical-based models for producing nowcasts and NTFs for key macroeconomic variables.¹ The data-driven forecasts allow to explore valuable information contained in high-frequency data, e.g., travel receipts and construction permits, which are leading indicators for economic activity and correlate well with the semi-annual GDP dynamics.

¹ This was facilitated by NRBT staff attending various IMF courses, both virtually and in-person, which cover analytical and empirical tools.

9. The set of NTF tools for main variables of interest (GDP growth and inflation) include several data-driven methods. Among these are the following: simple extrapolations of past trends; univariate methods (Autoregressive Integrated Moving Average (ARIMA)); bridge equations, where the statistical co-movement between GDP and a set of monthly/daily variables – extended over the short-run using simple univariate methods – is explored within a regression-based approach.

10. The medium-term macroeconomic projections are produced using a semi-structural QPM. It has a New-Keynesian four-block core, along the lines of Berg et al. (2006), which was adapted to reflect the stylized facts of the Tongan economy.

D. INTEGRATION OF TOOLS INTO INTERNAL PROCESSES AND EXTERNAL COMMUNICATIONS

11. The model-based results are carried out by the Economics Team at the NRBT. Broadly, the team manages deadlines and responsibilities for deliverables, following NRBT internal forecast calendar. Among the critical tasks that staff perform are:

- Identify and delegate tasks.
- Integrate medium-term and near-term forecasts, identify risks, build alternative scenarios.
- Compile macroeconomic forecasts by reaching collective and consensual views.
- Draft materials for internal and external communication.
- Present analysis and interact with management.
- Build the forecast narrative based on model outputs and present policy recommendations consistent with monetary policy objectives.

12. The NRBT team consists of economists performing various roles on a rotation basis among NRBT staff to broaden their skillset and allow for continuous professional development. The key FPAS roles are:

- Coordinator (and backup): leads the forecasting team; communicates with management.
- Model operators: maintain, use and develop the forecasting tool and QPM infrastructure, and produce the model-based analysis.
- Database managers: ensure a timely, efficient, and error-proof data environment, which is essential for the analytical work.
- Sectoral experts (real sector, inflation, fiscal, monetary, exchange rate, external, etc.): develop sector-specific expertise compatible with the forecasting exercises and QPM; real-time monitoring of relevant variables (e.g., daily data for exchange rate and interest rates); near-term forecasting capacity; form a technical-based expert view on the recent, current, and short-term developments in relevant sectoral variables; participate in assembling the broader narrative and presentations to management.

13. NRBT's team sustainability is threatened by several risk factors. These, along with mitigation measures, were discussed with NRBT staff and management during the TA engagements and shared via Aide-Memoires (see Section IV for the final aide-memoire):

- The size of the team is small: NRBT could extend it by hiring more staff and should consider both internal mobility and new hires options.
- The team is involved in “non-FPAS work”: staff could be formally assigned (close to) full time to FPAS work to alleviate their non-FPAS workload.
- Risk of excessive turnover: there is a need for backup staff and a critical need to document forecasting and FPAS tools and processes (internal manuals and user guides with steps to run NTF models, QPM

analysis and forecast, etc. were prepared by NRBT staff and reviewed by TA team); practice staff rotation to broaden the skillset across individual staff.

- Key person risks: there is a need to ensure analytical knowledge and skills are spread more broadly and there are backup positions; make use of documentation materials to initiate new staff.

14. The forecasting process and the associated analytical workflow follow closely the NRBT policy making process. The Board of Directors normally meets once a month. Forecasts are presented at least twice a year for the release of the Biannual Monetary Policy Statements. Partial forecasts for key indicators such as inflation and foreign reserves are produced monthly. There is a formal internal forecast calendar related to each Monetary Policy statement release. External communication takes place monthly after Board approval. The Monetary Policy decision (MPD) is produced monthly followed by a press release distributed to the media, the private sector, government agencies and banks. The MPD is also publicly available on the NRBT website. In practice, the forecasting process is complex, involving many stages, data processing and use, application of a wide suite of models, and various human interactions. As such, the organization of the processes is fundamental for timely and continuous provision of analytical results, as well as for accumulation of capacity.

Section II. Overview of TA missions²

A. MISSION 1: NOVEMBER 2021 (VIRTUAL)

15. The scoping mission identified NRBT's TA needs. The mission's objectives were to i) understand the characteristics and components of the monetary policy framework (MPF) at NRBT; ii) understand the current NRBT policy decision-making processes; iii) review NRBT's existing tools and methodologies and identify complementarities between these tools and the prospective ones planned as part of the Macroeconomic Frameworks FPAS TA project; iv) understand the interactions between NRBT, MOF and the Tonga Statistics Department; v) provide NRBT Management and staff with an overview of the FPAS, and related ICD capacity development (CD); vi) prepare a work program for a multi-year Macroeconomic Frameworks FPAS TA with a near-term focus on training and capacity development.

16. The SM highlighted macroeconomic, organizational, and capacity challenges at NRBT and MOF. The NRBT is a small institution with limited resources both in terms of staff and available software. The capacity level at NRBT is a challenge for the implementation of this TA. Authorities have weekly, monthly and quarterly economic indicators, but face challenges in the compilation of data.

17. The mission team proposed to divide the implementation of the FPAS TA project into two streams. In the first stream, mission members would deliver tailored training and develop tools and techniques to improve the overall analytical capacity at the NRBT. The project's second stream would be devoted to developing the Quarterly Projection Model (QPM) for medium-term analysis and forecasting, integrating the macroeconomic analysis and forecasting capacities into the decision-making process, and streamlining external communications.

B. MISSION 2: MAY 2022 (VIRTUAL)

18. The first virtual TA mission conducted in the early pandemic period focused on building and developing analytical capacity at NRBT's in macroeconomic forecasting. It provided customized technical support and training to the staff of the NRBT on time series analysis and macro-econometric forecasting techniques. This mission was originally planned to take place in February 2022 but it was postponed due to the volcanic eruptions and resulting tsunami which occurred on January 15 and led to significant damage to public infrastructure.

C. MISSION 3: JULY 2022 (VIRTUAL)

19. Both in the previous and in this mission, the NRBT staff worked on hands-on exercises in EViews that complemented the lecture material. The mission involved virtual training covering the second part of the Macro-econometric Forecasting and Analysis (MFA) course (i.e., vector auto-regression, forecasting and forecast evaluation). This work helped prepare the staff at NRBT for the next topic in the agreed TA workplan (i.e., nowcasting). The staff was encouraged to use the techniques

² This section is based on Back to Office reports prepared after each TA mission.

presented in the training in their daily work, and to gather and catalogue Tongan data in EViews for use in the next missions.

D. MISSION 4: OCTOBER 2022 (VIRTUAL)

20. During this mission, with the support of the ICD TA team, NRBT staff formulated and estimated several models relevant for monetary policy at NRBT. NRBT staff constructed various inflation models and real GDP growth models for forecasting purposes, using basic regressions, ARIMA models, and vector auto-regressions. The forecasting results obtained with these models were then compared with NRBT's current forecasts (which are predominantly Excel-based moving average projections of trend) and evaluated using forecast evaluation techniques. This work involved intensive discussions among NRBT staff and the ICD TA team on the appropriate determinants of inflation and real GDP growth for Tonga.

E. MISSION 5: NOVEMBER 2022 (VIRTUAL)

21. The mission was the first of two on nowcasting tools and techniques. NRBT staff were introduced to several nowcasting models and associated statistical methodologies relevant for monetary policy at NRBT. The technical material was illustrated to the NRBT staff by customized technical support and hands-on, step-by-step workshops using EViews. By way of example, the workshops focused on formulating a nowcasting regression for real GDP for Vietnam and then estimating the economic model using various mixed-frequency estimators, including BRIDGE, MIDAS, and U-MIDAS. NRBT staff were also provided with EViews command-line scripts that allow them to easily replicate the workshops.

F. MISSION 6: FEBRUARY 2023 (IN-PERSON)

22. During this first in-person mission, NRBT staff solidified their knowledge on nowcasting methods by applying the tools and techniques learnt to Tongan data. With the help of the ICD TA team, the NRBT staff customized the technical material on nowcasting based on EViews. The work first focused on formulating a nowcasting regression model for real GDP for Tonga and identifying and estimating the preferred economic model using the BRIDGE approach to address the mixed frequency problems. The ICD TA team assisted the NRBT staff in enhancing the Tonga-specific models for real GDP growth and inflation developed during the October 2022 mission.

23. During the second week of the mission, the ICD TA team instructed the NRBT staff on how to construct a *GDPNow* report, along the lines of the *GDPNow* report of the Federal Reserve Bank of Atlanta. This analysis allowed the NRBT to confirm their own intuition regarding the main sources of growth and their relative contributions using a model-based approach. This approach was also extended to nowcast the inflation rate and led to the creation of an *InflationNow* report for Tonga. These reports now feed into the work and internal policy discussions on the Tongan economy at NRBT.

G. MISSION 7: SEPTEMBER 2023 (VIRTUAL)

24. Following multiple missions covering macro-econometric forecasting analysis and nowcasting, this was the first virtual mission introducing Macroeconomic Diagnostics tools and the canonical Quarterly Projection Model (QPM). The training started with the economics of the real sector, presenting methods for estimating potential output and the output gap. It covered an analysis of the business cycle using the linear trend approach, the HP filter, the Bry-Boschan dating algorithm and the production function approach. This was followed by a study of the monetary policy stance, involving inflation targeting issues and various Taylor rules. All topics were complemented by hands-on workshops in Excel that illustrated the methodologies and theories presented in the lectures. The canonical Quarterly Projection Model was then introduced in general terms to prepare the NRBT staff for the next in-person mission where discussions about the building of the model and its calibration to the Tongan economy would begin.

H. MISSION 8: NOVEMBER 2023 (IN-PERSON)

25. During this mission, the ICD TA team completed training on Macroeconomic Diagnostics tools and continued the study of the QPM. The training started with the economics of the financial sector, presenting macro-financial linkages and financial soundness indicators. The fiscal sector and fiscal sustainability were studied at length, followed by a study of the external sector and external sustainability. All topics were complemented by hands-on workshops in Excel that illustrated the methodologies and theories presented in the lectures. This part of the work was helpful to solidify the knowledge of NRBT staff on interpretations of macroeconomic linkages across sectors and economic conditions in the near to medium term, including an assessment of the current policy stance. The NRBT staff were tasked to apply all the MDS modules and associated tools using Tongan data to produce an “IMF-style policy note” that will serve as their background document for policy discussions with the Governor and other counterparts as needed. The ICD TA team then continued the presentation on the canonical QPM introduced during the previous mission. The NRBT staff started discussing the steps involved in adapting the canonical QPM model to the case of Tonga.

26. During the mission, and notably during the application of the MDS tools to Tonga, it became clear that the NRBT would benefit from having a structured data management system in place, outside of Excel, to facilitate their work. The ICD TA team discussed the setting up of such a system for the economic time series used regularly by NRBT staff. Practical sessions demonstrating how this can be established in EViews and tied to Excel for daily use were included in the next in-person January 2024 mission.

I. MISSION 9: JANUARY 2024 (IN-PERSON)

25. The training started with the theoretical presentation of the canonical QPM. This involved explaining the four building blocks of the model: aggregate demand, inflation, uncovered interest parity and a Taylor rule for interest rate policy setting. Each block was studied and interpreted carefully. The model was then illustrated using EViews, to reflect the methodologies and theories presented in the lecture. This part of the work was helpful to solidify the knowledge of NRBT staff on interpretations of macroeconomic linkages across the four blocks of the model, including an assessment of the economic conditions in the near to medium term and the policy stance. NRBT staff reflected on the steps involved in

adapting the canonical QPM model to the case of Tonga, given that Tonga is not an inflation targeting country, and to implement it using EViews.

26. During the mission, the NRBT staff updated the *GDPNow* and *InflationNow* reports for Tonga developed in the previous in-person mission. These methodologies are being updated regularly to inform the monetary policy discussions at NRBT. Discussions with NRBT senior management were then continuing regarding the prospective release of these reports to the public.

27. The NRBT staff, with the help of the ICD TA team, started to implement a structured data management system in EViews. The objective was to simplify their work and reduce costly data-related errors that can easily arise in Excel. The ICD TA team first delivered a lecture on time series data management and then discussed the setting up of a data management system for the economic time series used regularly by NRBT staff. Practical sessions demonstrating how this can be built in EViews and tied to Excel for daily use were also part of this mission.

28. On the last day of the mission, Tonga's revised macroeconomic assessment for January 2024 and a brief introduction to the canonical QPM were presented to the Governor of NRBT. The Governor emphasized his enthusiastic support and strong interest in the work on Tonga's macroeconomic assessment and the development of a core macro model for medium-term policy analysis.

J. MISSION 10: JUNE 2024 (IN-PERSON)

29. During this mission, the ICD TA team worked with NRBT staff on developing a customized Quarterly Projection Model (QPM) for Tonga, using an EViews-based platform. The mission work started with a review of the theoretical foundation of the canonical QPM. The ICD TA team then helped the NRBT staff reflect on the adaptation of the canonical QPM model in EViews to Tonga, which is not an inflation targeting country and mainly conducts monetary policy using exchange rate interventions. The monetary policy transmission in Tonga (as for other Pacific Island countries) is rather limited due to the small size of the economy, its openness to international trade, a low level of financial market development, and a heavy reliance on remittances. Following the calibration exercise, the ICD TA team instructed the NRBT staff on how to implement various exogenous shocks and understand their impact on key macroeconomic variables in the model.

30. The ICD TA team reviewed with the NRBT staff the *GDPNow* and *InflationNow* reports for Tonga developed in the previous in-person missions. These methodologies are being updated regularly to inform the monetary policy discussions at NRBT. The ICD TA team also helped with the updating of the macroeconomic assessment for Tonga. These tools support the medium-term model for forecasting and policy analysis developed during this mission, which will be updated on a regular basis to reflect Tonga's stylized facts. Lastly, the ICD TA team continue to provide support in setting up a structured time-series data management system using EViews.

K. MISSION 11: JANUARY 2025 (IN PERSON)

31. This was the final mission of the project. The ICD TA team first worked with NRBT staff on revising the QPM developed in previous missions and using it to examine the impact of various exogenous shocks that could affect the Tongan economy. The ICD TA team also helped the NRBT staff

update the macroeconomic assessment for Tonga, including the nowcasting reports developed in prior missions. Lastly, the ICD TA team reviewed the progress NRBT staff made toward establishing a structured time-series data management system for NRBT using EViews workfiles.

32. Once the calibration of the QPM was finalized and solved to yield the baseline solution, three scenarios involving exogenous shocks to the Tongan economy were analyzed. The first scenario analyzed a potential trade war between the United States and China. The second scenario considered a domestic riot (political instability) that resulted in significant destruction of the capital stock, which mimicked a domestic riot in Tonga in 2006 that destroyed 60 percent of the business district. The third scenario analyzed the impact of an unexpected decline in remittances and foreign aid to Tonga.

33. In addition to developing and studying the impact of these scenarios using the QPM, the ICD TA team reviewed the *GDPNow* and *InflationNow* reports for Tonga that were developed in previous in-person missions. The *GDPNow* is based on travel receipts, construction permits, total agriculture, and currency in circulation as high frequency indicators, while the inflation nowcast uses New Zealand dairy, New Zealand construction, oil, NEER, domestic and imported food prices as high frequency indicators. These reports are being updated regularly to inform the near-term and medium-term forecasts and the monetary policy discussions at NRBT and are released to the public on the NRBT website.

34. The ICD TA team helped NRBT staff develop additional nowcasting models. First, a model for imports, based on import payments (Overseas Exchange Transaction (OET) data), container registrations, and exchange rates. A nowcasting model for non-seasonally adjusted remittances was also developed, based on travel receipts (OET data), private transfers, social benefits, and compensation of employees as high frequency indicators, along with a crisis dummy and seasonal dummies. Lastly, the NRBT staff, with the help of the ICD TA team, updated the June 2024 Tonga's macroeconomic assessment to reflect macroeconomic developments during the second half of 2024. The team also worked on the implementation of a structured time-series data management system in EViews.

35. NRBT staff displayed confidence in using the training acquired in previous missions to produce more elaborate reports for NRBT senior management. NRBT staff regularly collect and update high frequency (e.g., monthly) Tongan data, to be used to nowcast annual/semi-annual real GDP growth and annual inflation, on a regular basis. They also practiced extensively during this mission how to script their work using the EViews command language. This will help to replicate existing reports and effectively document the specific steps taken to produce the nowcasts reported online.

36. During the concluding meeting, chaired by the Governor Mr. Tatafu Moeaki, the mission team discussed the achievements of the TA Project. The usefulness of the Tonga-specific QPM for the analysis of alternative scenarios was showcased by Ms Mefilina Tohi (Chief Manager of Economics at the NRBT), in the presence of Mr. Daniel Taumoepeau, Assistant Governor (Policy), and Ms. Ungatea Latu (Deputy Governor). In addition, Ms. Tohi presented the latest nowcasting reports. At the end of the meeting, the Governor and Deputy Governor both emphasized their ongoing enthusiastic support and strong interest in the continued production and use of the Tonga's macroeconomic assessment, nowcasting reports and the core macro model for medium-term policy analysis and forecasting as part of NRBT's operations.

Section III. Working Paper Outputs

A. IMF WORKING PAPER WP/23/153

37. IMF Working Paper 23/153 “Assessing the Impact of Policy Changes on a Nowcast”, co-authored by the ICD mission team, was published in July 2023. Nowcasting enables policymakers to obtain forecasts of key macroeconomic indicators using higher frequency data, resulting in more timely information to guide proposed policy changes. A significant shortcoming of nowcasting estimators is their “reduced-form” nature, which means they cannot be used to assess the impact of policy changes, for example, on the baseline nowcast of real GDP. This paper outlines two separate methodologies to address this problem. The first is a partial equilibrium approach that uses an existing baseline nowcasting regression and single-equation ARMA(p,q) forecasting models for the high-frequency data in that regression. The second approach uses a non-parametric structural VAR estimator recently introduced in Ouliaris and Pagan (2022) that imposes minimal identifying restrictions on the data to estimate the impact of structural shocks. The second approach was illustrated using Tongan data.

B. FORTHCOMING WORKING PAPER

38. The ICD mission team and the NRBT Assistant Governor (policy) co-authored the paper “A Quarterly Projection Model for Tonga”. This paper calibrates a gap model to the Tongan economy. The model generates medium-term quarterly projections of key macro variables (output, inflation, interest rate, and exchange rate). The canonical QPM model requires considerable modification because Tonga is not an inflation targeting country. It conducts monetary policy mostly by using exchange rate interventions. Moreover, the monetary policy transmission mechanism in Tonga (like other Pacific Island countries) is rather limited owing to the small size of the economy, an abundance of excess liquidity in the banking system, Tonga’s openness to international trade, a low level of financial market development, and heavy reliance on remittances.

To approximate Tonga’s characteristics, the model and its chosen calibration involves the following key features:

- The aggregate demand equation assumes moderate persistence in the output gap and a monetary condition index with more weight assigned to the exchange rate gap compared to the interest rate gap. This is done to account for the role of remittances and a high import-to-GDP ratio. The aggregate demand equation also assumes relatively low policy passthrough (reflecting the weak monetary policy transmission mechanism), and a low impact of external demand on domestic output (given Tonga’s very low export-to-GDP ratio).
- The aggregate supply equation reflects two different price considerations: high persistence of core inflation and low persistence of domestic food and energy prices. The Tongan Government is a major player in the economy and civil servants comprise most of the labor force. Due to budget constraints, nominal wages have been rather sticky and have not changed much over the years. As such, nominal prices of goods and services also tend to be sticky, contributing to a rather persistent core inflation. On

the other hand, domestic energy prices are fully exposed to volatile world price movements, with substantial (i.e., near full) passthrough effects. Moreover, domestic food prices are extremely sensitive to weather conditions.

- External price stability in Tonga is defined in terms of the stability of its currency. The exchange rate arrangement serves as a nominal anchor, and it responds slowly to external shocks and/or exchange rate misalignments. Though the Tongan Pa'anga is pegged to a basket of currencies, the Reserve Bank has the flexibility to adjust the exchange rate to address misalignments.

- Given that the exchange rate is the nominal anchor, monetary policy in Tonga is necessarily tied to the objective of exchange rate stability. The Taylor rule for Tonga displays strong persistence with respect to domestic interest rates, but low persistence to the output gap and the inflation gap relative to its reference rate of 5 percent (which the model assumes as a target). Interest rates in Tonga are not sensitive to movements in world interest rates. This is due to an abundance of excess liquidity in the banking system as well as capital control measures imposed on investment outflows. The excess liquidity in the banking system has increased to over 30 percent of GDP, which has effectively rendered monetary policy's transmission ineffective. Though negative shocks have been offset by inflows of foreign aid and remittances, the inflows also contributed to the accumulation of excess liquidity over the years because the Reserve Bank has not sterilized any of the increases in foreign reserves. The interest rate on excess reserves, which acts as the policy rate, has been constant at zero percent (since 2012). Moreover, the Reserve Bank has not issued any notes (or conducted open market operations) since 2009.

The calibrated QPM model is used to study three scenarios and assess their impact on the baseline projections. Tonga, having experienced a natural disaster every 2 years since 2014 (various tropical cyclones and the volcanic eruption and tsunami in 2022) in addition to the COVID-19 pandemic, was bracing itself for another natural disaster in 2024. Businesses were struggling to pay back loans after being affected by these disasters. This led to an increase in non-performing loans and a deterioration in banks' financial position and performance. Among them, one bank deteriorated significantly more than the others. Given the above, the first scenario involves several shocks proxying for a bank failure. The second scenario introduces shocks that capture the consequences of a natural disaster. Lastly, the third scenario introduces shocks that represent a significant negative external shock to the Tongan economy. The three scenarios were chosen to reflect the sensitivity of Tonga to adverse financial shocks, to their trading partners' macroeconomic policies, and to extreme weather events.

Section IV. Aide-Mémoire (Post January 2025 Mission)

The training and tools in macro-forecasting, nowcasting, macro-diagnostics, and quarterly projection models delivered between 2022 and 2025 (ten missions in total) led to the development of 4 main outputs:

- **Nowcasting reports for GDP and Inflation.** These reports should be revised monthly and become key inputs in communication for upper management. These reports could also be published on the NRBT website for broader dissemination.
- **Macroeconomic review.** The analysis of vulnerabilities and risks, and associated recommendations included in this report extend beyond the existing NRBT reports provided to management. This new report, together with the current monthly staff reports, could enrich discussions on intersectoral linkages, thereby supporting monetary policy formulation. The Macroeconomic review should be revised at least quarterly and become a key input in the monetary policy meetings.
- **Quarterly Projection Model (QPM) for Tonga.** The model allows for the assessment of various exogenous shocks on key macroeconomic variables over the medium term. The calibration of the model will need to be assessed and refined on a regular basis, depending on the acceptability of the baseline projections and forecasting performance. Consistency across sectors will be key to this exercise. For this to be done successfully, the input data for the QPM needs to be maintained and updated as new Tongan data is released. Staff should continue to use on a regular basis the EViews implementation of QPM to remain proficient in solving the model and interpreting the outcomes with and without shocks.
- **Structural time-series data management systems.** Such systems are critical for the conduct of sound economic policy. They will improve the efficiency of NRBT staff in preparing various high-quality notes as requested by management, compared to the use of an error prone and inefficient Excel based data system.
- In response to questions from management, staff should be ready to
 - Formulate appropriate exogenous shocks to the baseline using the QPM methodology and interpret the results proficiently.
 - Prepare briefs and presentations for upper management addressing the questions asked.
 - Prepare notes to be published, conditional on upper management approval, on the NRBT website for external audiences, to promote communication outside of NRBT, to foster financial inclusion and financial literacy among the public, and the credibility of NRBT policy making in the public domain.

Section V. References

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