TECHNICAL ASSISTANCE REPORT

THAILAND

Technical Assistance to the Ministry of Finance – Development of a Dynamic Stochastic General Equilibrium Model

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DONORS

Japan

Contents

ACRONYMS AND ABBREVATIONS

ADB	Asian Development Bank
BB	Budget Bureau
BOP	Balance of Payments
BOT	Bank of Thailand
BOTMM	Bank of Thailand's Macroeconometric Model
BPA	Budget Procedure Act
CD	Capacity Development
CES	Constant Elasticity of Substitution
CGE	Computable General Equilibrium
CQM	Current Quarter Model
CSV	Coma-Separated Values
DFP	Division of Fiscal Policy
DMP	Division of Macroeconomic Policy
DSA	Debt Sustainability Analyses
DTP	Division of Tax Policy
DSGE	Dynamic Stochastic General Equilibrium
FPAS	Fiscal Policy Analysis System
FPC	Fiscal Policy Committee
FPO	Fiscal Policy Office
FRA	Fiscal Responsibility Act
FRMC	Fiscal Risk Management Committee
FXI	Foreign Exchange Interventions
FY	Fiscal Year
GDP	Gross Domestic Product
HQ	Headquarters
ICD	Institute for Capacity Development
IPF	Integrated Policy Framework
IRF	Impulse Response Function
IT	Information Technology
LIQ	Liquidity Constrained Households
MAMUANG	Macroeconomic Forecasting Model of Ministry of Finance of Thailand
MCM	Monetary and Capital Market Department at the IMF
MMFS	Macroeconomic Modeling and Forecasting Section
MOF	Ministry of Finance
MPMIPA	Monetary Policy Model for an Integrated Policy Analysis
MTDS	Medium Term Debt Management Strategy
MTFF	Medium Term Fiscal Framework
NESDC	Office of the National Economic and Social Development Council
NTF	Near-Term Forecast
OLG	Overlapping Generation Households
OLS	Ordinary Least Squares
PDF	Portable Document Format
PDMO	Public Debt Management Office

QFM	Quarterly Financial Model
QIPF	Quantitative Integrated Policy Framework
QPM	Quarterly Projection Model
STAMP	Structural Analysis of Macroeconomic Policies Model
STX	Short Term Experts
TA	Technical Assistance
VAT	Value-Added Tax
WEO	World Economic Outlook

PREFACE

This report marks the beginning of a capacity development project between ICD and the Ministry of Finance of Thailand. The project, initiated at the request of the Fiscal Policy Office (FPO) of this Ministry, aims to develop and operationalize a structural model (and, in particular, a dynamic stochastic general equilibrium model) for macroeconomic policy analysis between end-2024 and mid-2026. The report's goal is twofold: on the one hand, convey to the authorities the project's team assessment on the current toolkit, capacity, and institutional mechanisms to conduct fiscal policy and macrostructural analysis; on the other, to register the action plan for the project, agreed with the authorities during the mission, that will guide the delivery of technical assistance and enshrines work commitments on both the Fund and MOF's side.

The scoping mission of this project took place in Bangkok, Thailand, from November 18 to 26, 2024. The mission team, led by Alberto Soler (Project Chief and Senior Economist) and Michal Andrle (Deputy Division Chief), included Daniel Baksa (Economist) and Mirza Gelashvili (Economist). To complete its diagnostic, the mission held meetings with Mr. Warotai Kosolpisitkul, International Economic Advisor of the Fiscal Policy Office; Mr. Pisit Puapan, Executive Director of the Division of Macroeconomic Policy; Mr. Norabajra Asava-Ballobv, Section Chief of Economic Data Innovation and Research; Mr. Youthapoom Charusreni, Section Chief of Macroeconomic Modeling and Forecasting; Mr. Surach Tanboon, Senior Director of the Monetary Policy Department in the Bank of Thailand; Mr. Sirus Pussayanavin, from the Public Debt Management Office. The mission also worked on an introductory training on DSGE models with 14 staff from different divisions within the Fiscal Policy Office.

We would like to express our sincerest gratitude to the Fiscal Policy Office for their warm hospitality, excellent organization, and logistical support provided throughout the mission. We especially wish to thank Mr. Chanon Limpasitipon, Senior Economist at the Section of Macroeconomic Modeling and Forecasting, and Dr. Youthapoom Charusreni, Chief of the same section, for the outstanding coordination of the mission on the MOF side, along with their team members, for their commitment and dedication shown during the training sessions. Additionally, we want to express our gratitude to the country team of Thailand from the Asia and Pacific Department (APD), led by Ms. Corinne C. Delechat, for the fundamental support provided for the project, to Mrs. Eteri Kvintradze, Director of CDOT, for her helpful logistical advice, and to the MCM and FAD teams who kindly collaborated during the preparation of this mission.

EXECUTIVE SUMMARY

Structural models play a crucial role in informing sound macroeconomic policy decisions. They provide an analytical framework that is fully consistent with economic theory, reflect the optimal decisions of households and firms, and allow for the introduction of fiscal and monetary responses to deviations of the economy from its long-run equilibrium. Due to these characteristics, structural models have become integral to fiscal forecasting and policy analysis systems (FPAS) in many countries and represent an excellent complement to medium-term, nowcasting, and near-term forecasting tools. Dynamic Stochastic General Equilibrium (DSGE) models are a particularly useful type of structural model, as they differentiate the effects of various shocks and policies over the short and medium run, capturing a comprehensive network of simultaneous interrelations between the sectors of the economy.

In Thailand, the fiscal FPAS is fundamentally defined by the Fiscal Responsibility Act and the Budget Procedure Act. Medium-term macroeconomic and fiscal projections, structured around the Medium-Term Fiscal Framework (MTFF), are a joint responsibility of the Ministry of Finance (MOF), the Budget Bureau (BB), Office of the National Economic and Social Development Council (NESDC), and the Bank of Thailand (BOT). The collaboration among these four stakeholders, each with distinct comparative advantages in macroeconomic and fiscal analysis, offers significant opportunities. However, these opportunities have not yet been fully exploited, particularly regarding policy and structural analysis. The coordination and oversight mechanisms embedded in current legislation have primarily focused on producing a baseline medium-term scenario, while collaborative quantitative assessments of policy options, macroeconomic shocks, and longer-term economic trends have not received primary attention and went unpublished.

Over the past decade, the MOF has relied on its core forecasting model, MAMUANG, to produce policy and risk scenarios. Like other large-scale econometric models, MAMUANG has some limitations for simulation, and there is room to improve its economic intuitiveness and user-friendliness In contrast, a DSGE-based tool for simulation would offer multiple benefits, including higher transparency, internal consistency, and economic plausibility. In this context, the mission recommends that the FPO develop a tool based on the canonical ICD DSGE model, STAMP, as the starting point for customizing it to the structure of the Thai economy and MOF's reporting needs. Furthermore, the adoption of STAMP will enable MOF authorities to address critical policy questions, such as the impact of different transfer schemes, changes in minimum wages, the consequences of alternative fiscal paths and funding schemes within the existing regulations, and the effects on long-run growth of productivity-enhancing fiscal and structural policies. This type of tool would also foster more intensive and fruitful collaboration with other government stakeholders on policy analysis.

To achieve the development and implementation of this tool, the mission and the authorities have agreed on an Action Plan for the project over the next two years. The project will be structured into seven missions over approximately one and a half years, with a six-month buffer for any additional activities that may not be necessary. Capacity building in the DSGE model is expected to yield substantial returns for the MOF, enhancing not only the solidity of the fiscal strategy and its communication, but also significantly strengthening its human capital. Further, capacity building could also have positive spillovers into the eventual improvement of other elements of the FPO analytical toolkit in the future. However, like any profitable asset, this project requires a strong initial investment of time and effort. To maximize the

chances of success, the Action Plan establishes a set of mutual commitments. Ensuring sufficient time for the FPO team to work on this project, promoting continuous engagement during and between missions, and providing effective incentives for stable participation are essential goals throughout the duration of the project.

I.   INTRODUCTION

1.   The Thai economy can be characterized as a small open emerging economy pursuing a inflation targeting regime and a debt-based fiscal rule. The BOT operates in an inflation targeting regime and has a built a solid credibility. The country is well integrated and global value chains and the capital account is relatively open, although some capital flow management measures are used to reduce exchange volatility. Fiscal policy is anchored on a public debt medium-term anchor, which provides room for counter-cyclicality in the near-term, while government deficits tend to be low.

2.   The Ministry of Finance (MOF) of Thailand, through its Fiscal Policy Office (FPO), requested on March 22, 2024, technical assistance (TA) from ICD, to develop a customized dynamic stochastic general equilibrium model (DSGE) for simulation and analysis of macroeconomic policies. Upon study of the request, this project was included in ICD's FY25 work program and obtained funding assurances from the Government of Japan.

3.   The pre-scoping meeting took place on May 29, 2024. ICD representation was led by Mr. Juan Sebastián Corrales (ICD). Mr. Pisit Puapan, Executive Director of the Division of Macroeconomic Policy (DMP), and Mr. Chanon Limpasitipon, from the Macroeconomic Modeling and Forecasting Section (MMFS), attended on the side of the FPO authorities. The meeting reviewed the authorities' needs, and a more detailed questionnaire submitted by ICD was responded by the Thai authorities some weeks later. Following the meeting, it was agreed that the scoping mission would be fielded in Bangkok by mid-November 2024.

4.   The DMP is part of the FPO, hosts the MMFS, and has an important role in the fiscal Forecasting and Policy Analysis System (FPAS) in Thailand. The FPO is one of the key departments of the MOF, together with the Customs, Excise, Revenue, Treasury and Comptroller General departments, as well as the Public Debt Management Office and the State Enterprise Policy Office. Within the FPO (see Figure 1), technical divisions are grouped in three missions (macroeconomic and international, fiscal and financial), with the DMP belonging to the first of them. Within the DMP (Figure 2), forecasting work is concentrated in MMFS, although there are four divisions with complementary assignments. As detailed in Section II, the DMP produces short- and medium-term macro-fiscal projections in the MOF. At a governmental level, official projections follow a process well defined by the Fiscal Responsibility Act, and involve other stakeholders external to the MOF. The DMP also produces, on an ad-hoc basis, alternative scenarios reflecting the materialization of macroeconomic shocks and studying the effects of fiscal policies. More precisely, the analytical outputs that the DMP produces regularly are:

   a) **Forecasts:** The first one is the Quarterly Economic Projections, which contain annual forecasts on the main macroeconomic aggregates for the ongoing year and the next one. The second one

is a medium-term forecast over 5 years, as an input for the Official Medium-Term Fiscal Framework.

b) **Analytical Reports**: The three most important are: (i) Economic Analysis Reports on the impact of fiscal policies (spending and taxation) on several areas of the Thai economy, such as digital payments, tourism, credit accessibility, etc.; (ii) Economic Weekly and Monthly Reports, analyzing a set of macroeconomic and sectoral indicators and occasionally conducting more in-depth analyses; (iii) Macro Morning Focus for Executives, with an overview of latest data for internal circulation.

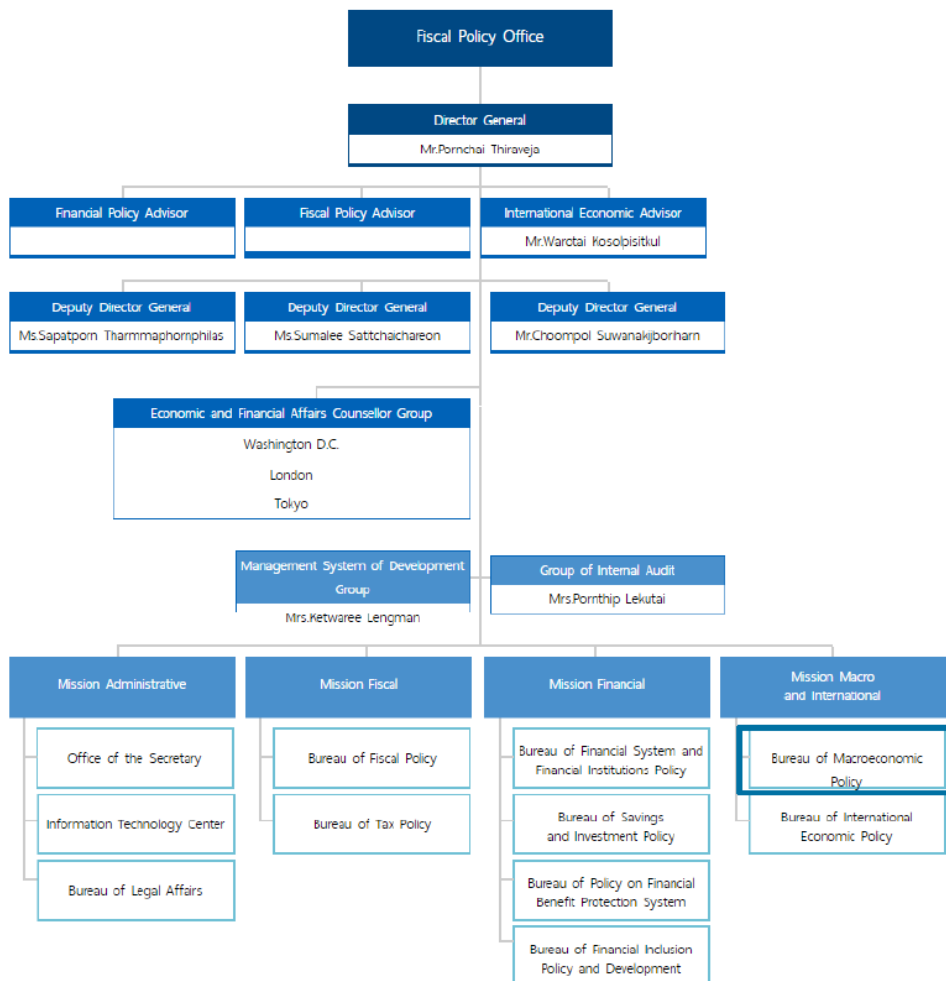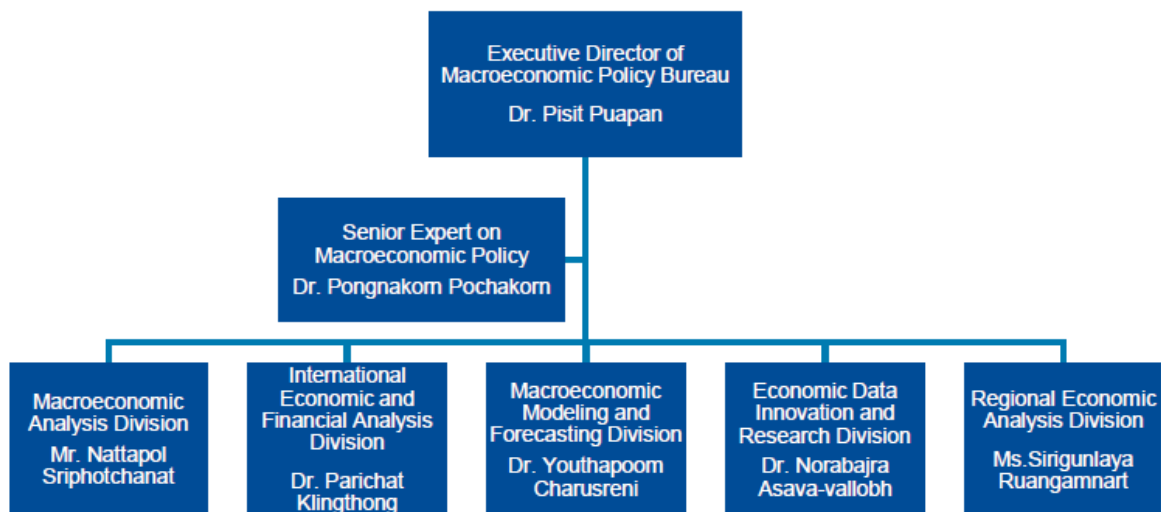**Figure 1: Structure of the Fiscal Policy Office (MOF)**

Figure 2: Structure of the Macroeconomic Policy Bureau

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                    │   Executive Director of     │
                    │ Macroeconomic Policy Bureau │
                    │     Dr. Pisit Puapan        │
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              ┌──────────────────────────┐
              │    Senior Expert on      │
              │  Macroeconomic Policy    │
              │ Dr. Pongnakorn Pochakorn │
              └──────────────────────────┘
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Macroeconomic Analysis Division	International Economic and Financial Analysis Division	Macroeconomic Modeling and Forecasting Division	Economic Data Innovation and Research Division	Regional Economic Analysis Division
Mr. Nattapol Sriphotchanat	Dr. Parichat Klingthong	Dr. Youthapoom Charusreni	Dr. Norabajra Asava-vallobh	Ms.Sirigunlaya Ruangamnart

II. CHARACTERISTICS OF THE FISCAL FORECASTING AND POLICY ANALYSIS SYSTEM (FPAS) IN THAILAND

A. LEGISLATIVE FRAMEWORK, FISCAL RULES AND THEIR OVERSIGHT

5.   Thailand's fiscal management framework is underpinned by a set of laws that regulate the preparation of the fiscal strategy, set fiscal rules and allocate responsibilities for their oversight. The 2017 Constitution represents the foundational document that sets principles aimed at achieving: i) financial discipline, ii) a fair tax system and iii) a strict oversight of revenue and expenditure as the three cornerstones of the fiscal framework. The 2018 Fiscal Responsibility Act (FRA) instructs the government to prepare every year a 5-year Medium-Term Fiscal Framework (MTFF), the key strategic fiscal document, reflective of the policy priorities enshrined in the National strategy. The same FRA also enshrines a fiscal rule, and assigns a Fiscal Policy Committee (FPC) the responsibility within the government to enforce its compliance. Lastly, the 2018 Budget Procedure Act (BPA) defines a results-oriented budgetary system, with a budget year that starts in October, and mandates the preparation of a Medium-Term Expenditure Framework that covers at least 3 outer years after the budget year. In the area of government financing, the 2005 Public Debt Management Act (PDMA) set out the key principles that have informed subsequent legislation.

6.   The fiscal rule comprises two legs, the first of which sets limits to some expenditure items and the second to public debt:

-    The expenditure rule establishes that the capital expenditure must account for no less than 20 percent of the total budget and not less than the budget deficit. In addition, the FPC will set limits for the shares of the central contingency fund, debt principal repayment and multi-year commitments on the budget (currently 2-3.5, 2.5-4 and 10 percent, respectively). The FRA and the PDMA does not specify a frequency for the revision of these ceilings.

-    The debt rule. A maximum debt to GDP ratio set by the FPC, initially at 60 percent, to be revised by the FPC at least every three years (currently 70 percent in the wake of the COVID-19 pandemic). Additionally, the FPC will set limits to the ratio of debt service to revenues, the share of debt denominated in foreign currency to total public debt and the ratio of foreign currency debt-to-exports-of-goods-and-services (currently at 35, 10, and 5 percent, respectively). If the prescribed ratios cannot be met, the MOF shall report to the Council of Ministers reasons for the deviation, and methods as well as timeframe to return to the targeted ratios. The frequency of the revisions of these ratios is not defined ex ante. Annual debt management strategies and the public debt path in the MTFF must conform to the limits set by the FPC.

7.   The FRA tasks with the FPC with the discussion and approval of the MTFF. The FPC is chaired by the Prime Minister, Vice-chaired by the Minister of Finance and the FPO acts as Technical Secretariat. The Office of the National Economic and Social Development Council (NESDC), Bank of Thailand (BOT) and Budget Bureau (BB) are also part of it. The FPC reviews, discusses and endorses the MTFF, on the basis of the multi-annual macroeconomic projections prepared by the NESDC,

expenditure projections from the BB, and revenue and debt projections from the MOF. The MTFF is approved in December, and is followed by the preparation of budget proposals by line ministries until February. Complementarily to the FPC, the FRA also contemplates the creation of a Fiscal Risk Management Committee (FRMC), integrated by the same stakeholders. The FRMC is responsible for the preparation of an annual Fiscal Risk Statement that assesses existing risks and proposes policy measures to mitigate them.

B. FORECASTING TOOLKIT AND PROCESS

8.   All of three main national forecasting bodies –the FPO, BOT, and NESDC—use a portfolio of models as inputs into their projections. Each institution publishes only annual-frequency projections, which are independent and not shared with the others until officially published. Each institution publishes their forecast in a different month (January – MOF, February – NESDC, and March – BOT, etc.) and the forecasting teams regularly interact to discuss common assumptions underlying the projection (foreign outlook, government policies, …), main economic events, and openly share data among themselves.

9.   The core forecasting tool of the FPO (Macroeconomic Forecasting Model of Ministry of Finance of Thailand, MAMUANG), is a large-scale econometric model which does not endogenize some fiscal variables. This quarterly model has over 300 equations and relies on error correction mechanisms estimated using a univariate OLS, with dummy variables and time trends to support trends. Among the exogenous variables used by the model, we could highlight GDP growth in the major trading partners, nominal exchange rate vs. US$, Dubai oil prices, tourism expenditure and government primary expenditure. The system of equations is solved in EViews, and its outputs exported to Excel and tabulated for discussion with the Ministry's management. The endogenous variables are projected by combining equations forecasts with add-factors, reflecting expert judgement and quarterly projections from the BOT and the NESDC. The MAMUANG computes a large block of macroeconomic variables, while Government revenues are forecast by the Division of Fiscal Policy using information provided by the DMP and collaborating with the relevant tax collection departments. Public debt projections are made by the Public Debt Management Office (PDMO), coherently with the GDP used by the FPO, similar exchange rate assumptions and their own interest rate forecasts.

10.   Exogeneous variables are projected by means of satellite models, expert forecasts of specialized agencies and FPO staff extensive judgement. Sectoral experts in the MMFS have developed their own satellite models for major trade partner GDP growth, exchange rate, tourism expenditure, oil prices and public expenditure. As a way of cross-validation, some of these experts hold analytical discussions with the BB, Comptroller's General Department and the Ministry of Tourism and Sports. Growth of major trade partners is also compared with WEO projections and trade data. Other satellite models forecast some aggregate indices in a bottom-up manner, such as inflation by aggregation of sub-components, and their results are then compared with the headline inflation projected by the system of equations. The MMFS also have Nowcasting and Near-Term Forecasting (NTF) tools, which rely on econometric and machine learning models. Their results are also used as an input for MAMUANG.

11.   Some features of the MAMUANG deserve careful consideration, regarding the interrelation between sectors, shock transmission channels and the Lucas critique. In spite of only cursory

information provided to the team about the MAMUANG model, the team has identified some possible concerns with the projection tool, its properties and its use, which suggest that the DSGE could complement it for policy analysis and communication of macroeconomic projections. Some of these issues are:

- Monetary policy does not play any role, either in the transmission of impulses to long-term interest rates or the determination of the spot exchange rate, which is entirely exogenous. By the same token, the exchange rate is not sensitive to changes in foreign interest rates or risk premia.

- Lack of a simultaneous determination of macroeconomic and fiscal variables can give rise to inconsistencies between both sets of projections. The latter may concern: (i) the calculation of disposable income, as the model does not determine direct tax collection; (ii) the inflation rate implicit in government expenditure assumptions and the one projected by the model after the introduction of these assumptions.

- For being a fully-fledged econometric model, estimated coefficients may be policy-dependent and unstable. Coefficients are currently re-estimated every 4-5 years, but this may not be an effective way to mitigate this problem. The sole use of estimated OLS coefficients could also pose risks related to endogeneity and affect the dynamic properties of the model.

12.   It is envisaged that the DSGE will complement, not replace the MAMUANG. A forecasting model of the scale is useful for many purposes. But it is difficult to comprehend and use for policy and scenario analysis[1]. This background, together with the fact that at present the authorities wish to keep their workhorse forecasting model, provides a solid rationale for the DSGE to supplement the MAMUANG for scenario analysis. Moreover, The MAMUANG can incorporate economic judgement and shocks by means of add-factors. This opens the possibility of incorporating the results of some DSGE policy scenarios, when needed, by identifying adequate combinations of add-factors and/or modifications in the paths of some exogenous variables. The fact that the MANUANG is developed in EViews also facilitates the introduction of tunes. In the medium run, though, the FPO could consider streamlining its forecasting model and studying its intersectoral consistency, as well as reviewing its dynamic properties and calibration. To that end, the experience that the team will gather during the DSGE project will be very useful.

13.   The MOF publishes short-term forecasts every quarter and contributes to the preparation of the MTFF once a year:

- Short-run estimates, published every quarter, include annual estimates for the ongoing year, and in the last quarter of the year also forecasts for the next one. Government expenditure assumptions used to prepare forecasts are displayed together with other exogenous variables. The MOF is the main responsible for these forecasts. Publication dates are April, July, October

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[1] The project left behind a user manual, and the team is able to operate the model. However, none of the original project member remain. Not surprisingly, then, the training sessions held during the mission evidenced that staff find it difficult to interpret some of its underlying economics, and the analysis of its results is not straightforward.

and January. The quarterly report that hosts these forecasts contains an analysis of revisions from the last forecasts.

- 5-year MTFF forecast, comprising nominal GDP, and government revenue, expenditure, fiscal balance and debt. In view of the MOF and BOT forecasts, and the results of its own models, the NESDC produces a complete set of medium-term macroeconomic projections, although only the GDP is published in the MTFF. The nominal GDP path is then shared with the TPB and the PDMO, for the calculation of government revenue, the stock of general government debt and interest payments. The whole set of macroeconomic projections is then approved by the FPC and published on the website of the MOF in December.

14.   The FPO holds regular contacts with other stakeholders in the forecasting process for information sharing and exchange of views. Every month, the FPO meets with the TPB and the PDMO, gathers their views on the situation of markets and revenue collection, and discuss the macroeconomic juncture in view of recent indicators. Contacts with producers of relevant statistics (essentially the ministries of Commerce, Industry, Tourism and Sports, and Agriculture and Cooperatives, as well as the BOT) are also frequent. In the run-up to the production of medium-term projections, FPO staff meet with the NESDC to harmonize assumptions and share impressions on the economic outlook.

15.   The availability of data for core policy analysis seems broadly adequate. Most typically used macroeconomic data (national accounts, BOP, labor market, monetary sector, etc.) are available at least at a quarterly frequency and with a regular publication calendar. The quarterly GDP data are published by the NESDC, alongside an updated projection. For the purpose of calibrating the DSGE model, no large data gaps have been identified. Nonetheless, the ICD team found some noticeable discrepancies between budget accounting and GFS, both in terms of outturns and classification, which would be important to address.

16.   FPO and MOF staff maintain multiple databases. Some databases, like large-scale fiscal policy operations databases and microdata, are maintained by IT staff using professional database software. The macroeconomic database in FPO is maintained in MS Excel on an internal shared drive. The vintages of the database are monthly archived. Each sector-assigned staff member is responsible for updating and maintaining the data of their respective sectors. IT staff also back up the internal share drive regularly. Given the available central macro database, the risk of staff using different vintages of data is reduced. FPO staff indicates that issues, if any, mostly arise for policy analysis where detailed micro data or data from specialized providers are needed. If the data exist, it is often too expensive relative to the needs of the analysis, or there are administrative barriers (privacy laws) to obtain those.

17.   The Bank of Thailand (BOT) uses a suite of economic, econometric, and machine-learning models. The analytical contribution of the BOT to the government FPAS is very relevant, and supported by a comprehensive analytical toolkit. The main model producing inputs for the projection is a large-scale econometric model "Bank of Thailand's Macroeconometric Model" BOTMM.[2] The core BOTMM model is smaller than FPO's MAMUANG model (94 behavioral equations and 76 identities), and also uses

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[2] See, for instance https://www.bot.or.th/content/dam/bot/documents/en/research-and-publications/reports/monetary-policy/mpr/appendixEng_Oct07.pdf or https://www.unescap.org/sites/default/files/Thailand-macroforecastingtechniques.pdf

estimated error-correction equations. It covers four sectors: real, monetary, balance of payments and fiscal sector. BOT publishes its short-term quarterly projections by the end of every quarter.

18.   **NESDC possesses a wide macroeconomic toolkit and plays an important role in the government FPAS, its specialization focusing om medium-term structural analysis** NESDC's forecasting toolkit comprises the time-series CQM (Current Quarter Model) for nowcasting and near-term forecasting (2 quarters) and a semi-structural macroeconometric model, QFM (Quarterly Financial Model) beyond the very near term. The QFM features around 30 endogenous variables and similar number of exogenous variables. Potential GDP projections are informed by growth accounting in the sample period conducted by means of a production function, as well as several assumptions on future growth drivers based on current trends, expected policy measures and targets. NESDC publishes short-term projections (estimates for the current year and one-year ahead by the last quarter of the present year) every second month of all quarters. Its medium-term GDP projections, partly informed by MOF and BOT views, are the basis for the MTFF. Within the policy analysis system, NESDC is predominantly specialized in the medium- and long-term, structural and sectoral policy priorities and their macroeconomic implications. Structural policy simulations in this institution are mostly conducted within a CGE framework based on Input-Output coefficients. This specialization profile makes NESDC a highly complementary analytical partner of MOF regarding structural policy analysis to be carried out in the future with the DSGE model.

C. MACROECONOMIC RISK AND POLICY

19.   **There are several existing tools for medium-term or long-term policy analysis among the FPO, BOT, and NESDC**. All institutions use their macroeconometric models to answer some of the policy questions. The BOT uses for most policy scenarios their newly developed semi-structural Monetary Policy Model for an Integrated Policy Analysis and BOT staff benefits from the MCM TA on Integrated Policy Framework (IPF). In the past, the BOT has developed a medium-scale Dynamic New Keynesian DSGE model, however it is not being used for policy analysis. FPO staff use their MAMUANG model for basic sensitivity to exogenous shocks, accompanied by external tools, studies, and expert judgment. Currently, no institution seems to maintain a DSGE model with a focus on sound macroeconomic dynamics and the fiscal sector.

20.   **The analysis of macroeconomic risks is an integral part of the internal forecasting process in the MOF, although there is room for broadening its scope and improving the toolkit.** The MMFS sometimes elaborates alternative scenarios by means of its forecasting core model, by modifying the paths of some exogenous variables such as oil prices or the exchange rate, or introducing add-factors in some equations reflecting judgement on risk factors. These scenarios are usually discussed in the internal FPO meetings that precede the publication of the quarterly forecasts, although there is not any pre-established frequency for their production. These scenarios are aimed at informing the discussions on the baseline projections, by providing a range of possible outcomes that capture essential risks. Output is presented as a table of numerical differences from the baseline. However, these exercises are necessarily limited, since the existing model lacks a real integration of macroeconomic and fiscal outcomes and some key transmission mechanisms are not captured by the model. More generally, the production of alternative scenarios should be conducted regularly, at least quarterly, be based on a structural or semi-structural model, and be accompanied by an analysis of the shock transmission mechanisms instead of being circumscribed to numerical results.

21.   The MMFS also assesses the macroeconomic effects of some fiscal policy measures, but the core forecasting model is not particularly well suited to this analysis. These exercises tend to be more sporadic, and focused on policies with a high direct budgetary impact (e.g., the introduction of subsidies to mitigate the effects of the COVID-19 pandemic). Results are also based on the core forecasting model, which offers the possibility of modifying the exogenous paths of several types of primary expenditure. The assessment of revenue measures is principally guided by some indicative multipliers of different types of taxes developed together with the tool, as the model does not contain a parametrization of tax rates. This framework is limitative when it comes to comparing different financing mechanisms of fiscal policies, or to expanding the analysis to non-fiscal structural policies, such as product or labor market regulations. In addition, because the model lacks explicit forward-looking expectations, important transmission channels -particularly relevant for fiscal policy or anticipated measures- cannot be considered.

22.   The PDMO conducts sensitivity exercises and stress tests on its baseline projections 3 times per year, to define its short- and medium-term targets[3]. Shocks refer to key parameters for debt dynamics, such as GDP, interest rates or exchange rates, and the materialization of explicit and implicit contingent liabilities in the public sector. The results of these exercises, over a 5-year horizon, inform the preparation of Annual Debt Management Plans, and their in-year revisions. Simulations are also useful to calibrate suitable buffers in the MTFF debt stock path, so that the upper band of plausible deviations of stocks, liquidity and foreign currency-denominated ratios do not breach the ceilings set in the fiscal rule. Further, these simulations have also been used as an input to update the debt-related limits of the fiscal rule in due time, taking also into consideration the cyclical position of the economy and the viability of undertaking discretionary consolidations when chances to break previous targets are high.

23.   Longer-term debt sustainability analyses (DSAs) would provide a complementary and valuable perspective to the definition of the debt strategy. DSAs over a 10-20 period provide additional insights on GDP and fiscal trends, such as the evolution of ageing-related expenditure or some tax bases linked to the size of the working force. Therefore, extending baseline projections into this horizon, together with customized deterministic shocks and probabilistic analysis, would reveal upside and downside factors on debt dynamics that are hardly discernible in shorter horizons. The FPO, DFP and the BB could also participate in the design of deterministic scenarios, contributing with their expertise in baseline macro-fiscal projections, and reporting the effects of selected shocks/major policy alternatives in their future structural model. DSAs could be conducted at least once per year, and become part of the information set used in MTFF discussions and MTDS updates.

24.   Policy analysis in the BOT has been relying on a semi-structural gap model, which shows the benefits for growth of fiscal-monetary coordination and macroprudential policies[4]. For policy analysis and selected scenarios, the BTO is using a semi-structural gap model (Monetary Policy Model for an Integrated Policy Analysis – MPMIPA) extended for a detailed financial and macroprudential sector. The fiscal sector of the model is highly stylized and aggregated. This extended gap model follows the

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[3] The perimeter used in stress tests is the whole public sector, including non-financial state-owned enterprises.

[4] While the Bank has developed a structural DSGE model in the past, the model is not maintained or used for policy simulations, given the perceptions that the semi-structural gap model is more flexible.

standard version of the QPM, development of which benefited from the IMF's technical assistance. The model features several sources of nonlinearities, stemming from the interaction of fiscal and monetary policy when the policy rate hits the zero lower bound, the effects of protracted low interest rates on debt accumulation and credit quality, and the consequences of the exchange rate appreciation on the export-driven real economy. Over the last years, the BOT has emphasized the use of the model for integrated policy analysis, underlining the benefits of fiscal-monetary coordination given lack of room for monetary policy, and the benefits of FXI and macroprudential regulation for growth.

25.   **The Bank of Thailand is also working with the IMF's MCM Department to operationalize an estimated DSGE (QIPF)**. Work begun in 2020, with a follow-up mission in 2022. In November 2024, the MCM team presented the BOT the banking extension to the model and provided training on policy scenarios using the estimated QIPF DSGE model. The ICD mission team has already liaised with the MCM team during the preparation of the scoping mission, and both agreed to extend this collaboration in order to reap synergies among the two modeling projects.

26.   **Some of the policy institutions maintain or are developing CGE models.** For macroeconomic analysis with sectoral and distributional details, the NESDC and the Ministry of Commerce have their in-house CGE models for assessing implications of selected risks and policies. At the NESDC, the QFM described in the previous section is used for policy scenarios together with a CGE, which incorporates both intra- and inter-temporal dimensions within a neoclassical growth model, featuring 12 production sectors and being fully calibrated using the social accounting matrix. FPO is also in an early stage of technical assistance from the Asian Development Bank (ADB) to develop its own CGE model.

27.   **MTFF preparation could benefit from a more systematic and deeper discussion of scenario analyses.** While policy scenarios based on major measures have occasionally been discussed within the government, a systematic scenario-based analysis of policy options has not yet been incorporated to the MTFF process. Policy scenarios, including both macroeconomic and fiscal outcomes, could reflect strategic alternatives, such as the pace of fiscal consolidation, funding options for social spending measures, or productivity-enhancing reforms. These scenarios could inform about the relative merits of each option in terms of stabilization and sustainability risks, and be discussed in detail by a technical working group of the FPO. DSAs, which often capture more in detail some long-term factors than structural models[5], could be a good complement to the discussion of these scenarios. By the same token, during the elaboration of the medium-term macroeconomic projections, MOF, NESDBC and BOT could make a more intensive use of macroeconomic shock scenarios as a way to better balance the risks implicit in the baseline.

28.   **The government publishes an annual Fiscal Risk Statement which includes a limited analysis of macroeconomic risks**. The report is jointly prepared by MOF, NESDC and BOT, and contains a data-based qualitative analysis of specific fiscal risks to revenue, expenditure and public debt, including explicit and implicit contingent liabilities. Particular emphasis is placed on discussing the drivers of recent trends and identifying areas that need close monitoring. Nonetheless, the analysis of macroeconomic risks and their potential fiscal consequences is largely absent. Including in the report a macroeconomic risk matrix reflecting the origin of risks, their probability and possible effects, together with

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[5] A typical example can be aging-related spending, which can require a significant customization in DSGE models.

several quantitative scenarios in general equilibrium, would make the discussion more meaningful by clearly showing the interrelations between macroeconomic, fiscal and financial variables, and those factors that can amplify or mitigate risks. The DSGE model could greatly contribute to enriching the report along these lines.

III. PROPOSED TOOL

A. RATIONALE FOR THE ADOPTION OF A DSGE MODEL

29.   A DSGE model would be a suitable option for enhancing policy and medium-term structural analysis. DSGE models are widely used at central banks and ministries of finance to assess economic scenarios and draw policy implications. These models are dynamic, meaning that they capture the behavior of macro variables over a given time horizon. The models have endogenous forward-looking expectations and embed uncertainty, with agents internalizing the stochastic nature of future economic developments. Furthermore, general equilibrium ensures that all agents and markets are linked, and that macroeconomic variables (market prices and quantities) must be determined simultaneously. Rich transmission mechanisms and solid microfoundations confer to these models clear advantages as simulation tools over the existing model.

30.   DSGE models have significant potential to improve policy discussions and internal and external communication of policy recommendations. DSGE models enable policy advisors to translate the policymakers' preferences into the model variables and reflect these preferences along with country characteristics. The model makes it possible to have economically consistent discussions over the economic conditions and how can they influence the outcomes of policy scenarios. Further, and even more importantly, the model is a powerful tool for warning about the consequences of policy measures over a longer horizon, considering their potential costs and benefits, and take prompt preventive or corrective action when necessary.

31.   The proposed tool will serve the FPO at the Ministry of Finance as a simulation model and deliver quantitative and qualitative analysis for structural and policy analysis, helpfully integrating macroeconomic and fiscal analysis. The structural macroeconomic model will not generate baseline projections, but its results can inform them, and steer the discussion between the FPO advisors and policymakers on the nature of macroeconomic shocks and potential policy implications. Moreover, the specific characteristics of this model will allow the MOF to answer several pertinent questions at the core of their interest, as described in the previous sections. The fact that simulation results encompass consistent macroeconomic, fiscal and debt outcomes in the short- and long-run puts this type of tool at an advantage with respect to the existing ones, which only offer a piecemeal analysis. In particular, the analysis of long-run debt dynamics could represent a useful complement to DSAs, and inform about the types of shocks and policy responses that could induce long-lasting or even permanent deviations from debt targets. Given the primary focus on fiscal policy analysis, which is planned on annual basis, an annual frequency for the DSGE seems the most suitable option.

32.   A DSGE at the MOF could also facilitate analytical collaboration between the MOF, NESDC and BOT on key structural reform areas. So far, policy and risk scenarios designed by the FPO have not been regularly shared with other stakeholders in the forecast process, who already have other tools better fitted for this work. This asymmetry has probably limited the breadth and depth of their analytical discussions around the short- and long-term macroeconomic impact of fiscal and macro-structural

reforms. The development of a DSGE-based tool at the MOF could induce different dynamics by bringing MOF's toolkit closer to BOT's and NESDC's, and incentivize a more intense collaboration.

B. CHARACTERISTICS OF THE STAMP

33.   The proposed model is a state-of-the-art New Keynesian DSGE, with sticky prices and other frictions that enable fiscal and policies to yield short-term effects on aggregate demand. The Structural Analysis of Macroeconomic Policies (STAMP) Model is the ICD in-house DSGE model developed for Technical Assistance (TA) purposes and capacity development for government agencies. The benchmark model, which will be taken as starting point of the project, can be easily extended and customized to better capture country-specific structural features. The model is based on a small-open economy and comprises fiscal and monetary policy blocks. It assumes two types of households, featuring different saving patterns, and one domestic productive sector. Long-term growth is exogenously driven by productivity and population growth. The law of one price holds for imports, and the economy is imperfectly integrated into international capital markets, as reflected by the uncovered interest parity condition, which is augmented by a country-risk premium. Box 1 below explains in greater detail the structure of the model. The model will be developed in annual frequency, which fits better with the fiscal policy focus pursued by the authorities and the frequency of the MAMUANG.

Box 1: Overall structure of STAMP

STAMP comprises four main building blocks:

1. **The household block** has intertemporal optimizing overlapping generation (OLG) consumers, who are savers, and liquidity constrained (LIQ) consumers, who are non-savers. Savers can smooth consumption over time because they have access to assets, including capital, and domestic and external bonds. Non-savers, on the other hand, are forced to consume their current income in every period. Non-saver households receive financial transfers from the government budget and are typical beneficiaries of the social system in the country. There are also real rigidities, such as external habit formation and nominal wage rigidities, for both types of consumers, helping to capture more realistic dynamic properties.

2. **The production block** consists of the following firms:

   a. Capital producers allocate domestic savings and foreign credits to supply capital to intermediate firms' production, the investors face market imperfections (investment adjustment costs) while operating under perfect competition and flexible prices.

   b. Intermediate firms produce domestic goods for retailers, using CES technology that combines capital and labor. These firms face monopolistic competition and nominal price rigidities.

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c. Retailers produce aggregate output for private and public consumption, private investment, and exports by combining outputs from intermediate firms and imports. They operate under perfect competition and flexible prices. The differentiated goods for consumption and investment also mean that the import content and the final market prices of the final goods are different.

3. **The government block** comprises the description of fiscal, monetary and exchange rate policies set by the Ministry of Finance and the Central Bank, respectively.

    a. The fiscal block: the government adheres to an intertemporal budget constraint, where deficits—when public expenditures surpass revenue—can be covered by issuing debt. On the revenue side, the government charges distortionary taxes on labor income, capital income, and consumption as well as lump-sum taxes. On the expenditure side, the government incurs current expenditures and targeted transfers. In terms of borrowing, the government has access to domestic and foreign debt; the financing plan is a function of the government's exogenous decisions. Fiscal policy is modeled as a forward-looking rule where the primary surplus responds to current and future deviations of total public debt with respect to a target. If the primary balance needs to be adjusted due to higher than targeted debt, in the baseline version of the model, the government adjusts current expenditures until the debt returns to the targeted level. Other revenue and expenditure instruments are modeled as exogenous autoregressive processes or can be also used as an additional instrument supporting the government to reach the public debt target.

    b. The central bank follows an inflation targeting framework under a fully flexible nominal exchange rate arrangement. The Taylor rule describes the monetary policy decision, in which the inflation reaction is sufficiently strong to react to inflation deviations from the target, preventing the real interest rate from generating excess demand and second-round inflationary pressure. The UIP condition describes the dynamics of the nominal exchange rate, where the actual exchange rate is a function of the domestic and foreign interest rate differential adjusted by the risk premium and the expected nominal exchange rate.

4. **The rest of the world block:** The behavior of key macroeconomic variables of the foreign sector is modeled exogenously. For instance, foreign inflation, external interest rates, and foreign GDP follow autoregressive processes that feature stochastic shocks. Foreign GDP affects the demand for exports, which also depends on the real exchange rate and the relative price of the goods produced by the domestic economy. Moreover, the foreign interest rate embeds a country risk premium that increases with the net foreign asset to GDP ratio.

To close the model, market equilibrium conditions are imposed. These conditions determine the equilibrium prices and quantities equalizing the demand and supply of goods, labor, capital, bonds, etc. They also involve the equilibrium conditions for external balance, i.e., the current account balance

consistently determine the changes in the country's net foreign debt with the net exports and foreign income position of the economy.

34.   Policy analysis priorities and the structural distinctive characteristics of the Thai economy will be considered for the customization of the tool, but the preservation of its tractability should be a key objective. The IMF team and FPO managers have discussed the intended operational use of the future DSGE model. FPO managers highlighted as priority fields of analysis the role of productivity-enhancing public investment and fiscal policies, unemployment dynamics, labor skills heterogeneity, tax reforms (VAT, tariffs) and other policies with redistributive goals (i.e., redesign of existing transfers or introduction of new ones, minimum wage increases, energy subsidies or debt moratoria). A sensitivity analysis of some key parameters associated with the fiscal reaction function could be another area of interest.[6] The mission team emphasized that it is important to strike a balance between the practical use of the model and its complexity, considering that developing sufficient capacity on DSGE models also takes time. In this respect, ICD's objective is not only to deliver a model, but also to develop capacity and achieve full ownership of the tool by FPO staff.

35.   The scoping mission began to discuss some possible areas for customization. As described in the Action Plan in section V, customization of the tool will take place in several rounds. Discussions with the team about customization started during the scoping mission, but will continue more substantively before and during the second mission. Some initial aspects raised by staff were: (i) the introduction of public investment in the model; (ii) incorporation of labor heterogeneity, with a large low-skilled segment of the labor force earning the minimum wage or even lower salaries in the informal sector; (iii) the economic impact of raising minimum wages; (iii) modelling of government subsidies to energy prices, which on some occasions have dampened headline inflation volatility despite Thailand being highly reliant on oil imports; (iv) reforms in the structure of the tax system, including VAT rises and a negative income tax; (v) the economic impact of an ageing society.

36.   The mission presented to the authorities some examples of the analytical possibilities of STAMP in the areas of fiscal and structural policies. Box 2 summarizes some of these examples for versions of the model not yet calibrated to the Thai economy. The authorities concurred that the depth and comprehensiveness of this analysis would offer an integrated and economically plausible answer to their questions, and acknowledged wide advantages of STAMP over their current tools in simulation work.


Box 2: Illustrative examples of scenarios generated with the canonical version of the STAMP

As part of the scoping mission, the IMF team provided an overview of the STAMP model through an illustrative example that was run and analyzed by the FPO staff. They were asked to test the dynamic properties of the model using the generic codes from STAMP. The teams analyzed the main transmission channels and conducted sensitivity analyses on the effects of expansionary monetary policy shocks with different interest rate elasticities; fiscal stimulus (financial transfers and current

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[6] The list of possible customization areas is not exhaustive.

expenditures) with varying shares of liquidity-constrained households; labor income tax changes under different planning horizons; the importance of sticky price assumptions under fiscal shocks; risk-off shocks with different levels of import substitution in production; foreign demand shocks with varying risk premium elasticities; and financial transfer shocks with different types of fiscal consolidations.

The last and main illustrative scenario during the scoping mission was the impact of social reform in STAMP, calibrated to a stylized emerging economy with an Inflation Targeting framework and a floating exchange rate regime, which properties are also plausible for the Thai economy. In the model scenario, we examined two scenarios as deviations from the baseline economic projection. In the first case, we analyzed the impact of increased financial transfers to low-income households in 2025. The transfer shock is one percent of the initial GDP and is assumed to fade out gradually in the following years. Fiscal policy finances the higher social spending through public debt issuance. The scenario describes the immediate and second-round effects of the higher spending. In the first year, real GDP increases by 0.6 percent as low-income households decide to increase their consumption expenditures. The fiscal stimulus has additional second-round effects on the economy: it generates higher domestic demand; the firms need to hire more labor to increase their production scale to satisfy this higher demand. The elevated the labor demand shifts the wages in the private sector and generates additional inflationary pressure calling for contractionary monetary policy. The higher consumption and more intense level of employment generate additional revenue for fiscal policy; however, the economic stimulus is not sufficient to cover the increased level of expenditures resulting in permanent shift of the public debt. This scenario[1] shows two things: (1) the model provides a narrative that consistently explains all agents' behavior along with the monetary and fiscal policy behavior; and (2) the model also allows us to quantify the impact of the examined policy shock and provide a detailed analysis of all relevant macroeconomic variables.
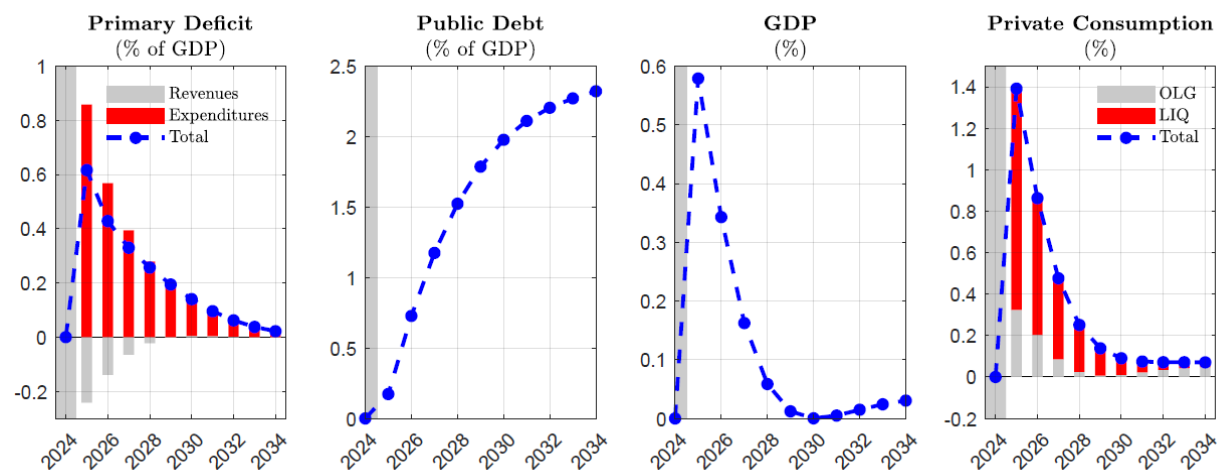
1/ Primary deficit and debt in percent of GDP as deviations in levels from steady state. GDP and private consumption in relative deviations from the steady state.

Our second scenario focused on the financing policies of the proposed social reform and analyzed the costs and benefits of different financing plans or consolidation strategies. The model provides a wide range of fiscal instruments to finance the increase in financial transfers. If the government wants to maintain the fiscal target defined in terms of the debt-to-GDP ratio, it needs to adjust other

expenditures or increase revenue. In this scenario, we compared two cases to the first scenario: financing the social reform via an increase in consumption taxes or increasing income taxation. These two options are equally efficient in keeping the public debt ratio around the baseline values; however, their impacts on real economic variables can be significantly different. Higher consumption taxes decrease consumption, offsetting the positive impact of increased financial transfers, while higher labor income taxes disincentivize household participation in the labor market, decreasing labor supply and generating a strong negative impact on real GDP. Furthermore, due to lower economic performance and reduced labor supply, especially in the case of labor tax increase, the firms decrease their demand for domestic capital, and the private sector postpones investments, undermining the potential growth of the economy. The charts below, expressed in the same units, nicely illustrate the strong policy storytelling capacities of the model. The model guides how the different expectations and distortions (or frictions) of the economy how matters for the outcome of the scenarios. Due to a rich fiscal block, the model provides insightful explanation that helps decision-makers in understanding the costs and benefits of different financing schemes and consolidation plans.
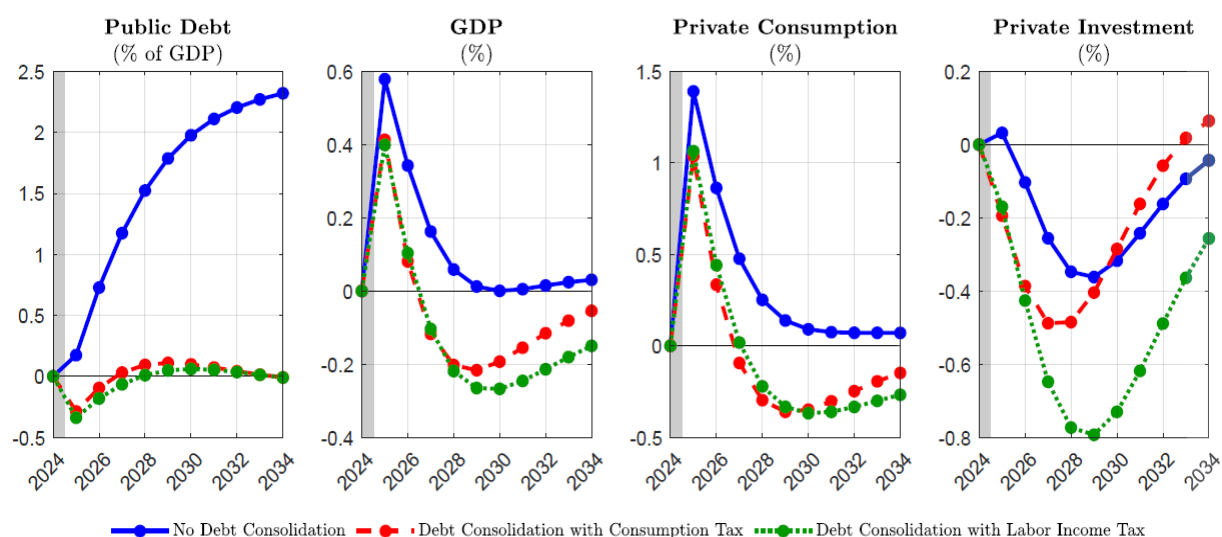
C. REPORTING AND SOFTWARE REQUIREMENTS

37.   The development of a standardized reporting system will be an important objective of this project. The project puts strong emphasis on teaching the MOF staff how to communicate policy messages and enhancing the model's storytelling capacities. To gain traction for the model, the tool must be equipped with a good, streamlined and informative reporting system that enables the team to deliver clear and relevant recommendations to policy makers. The tool will also produce effective inputs for presentations to senior management at the MOF in the form of charts and tables.

38.   The tool includes some reporting outputs by default, and offers the possibility of further customizing them to capture in a more detailed way transmission channels. The reporting system has two layers: (1) a ready-to-use collection of figures and tables as direct input for presentation that

embeds clear and simple charts from the model simulation; (2) a detailed diagnostic of the model that includes each agent's decision functions and inputs for their decision-making, thereby providing a deep understanding of the exact channels and transmission mechanisms, and upon request, additional explanatory figures. The project team will provide templates and an initial version of reports and model-based presentations. However, the reporting system is a living document, and the MOF staff receiving this TA will learn how to adjust the figures and tables, adding other variables when needed.

39.   The reports contain highly relevant macroeconomic variables of the model that are consistent with the variables the MOF communicates within the government and externally. These variables typically include GDP and its components, from expenditure, supply-side, or income-side decomposition; key nominal variables such as inflation, nominal interest rates, and nominal exchange rates; external balance variables including the current account, net exports, net foreign asset position, and real exchange rates; and finally, the fiscal block that describes the primary balance, expenditure and revenue sides, debt accumulation, and deficit path consistently with the assumed behavior of the fiscal framework. Additional pages list the foreign variables and exogenous assumptions. The reports can also compare the short and medium-term impacts of scenarios and also provide exact numbers in tables along with the figures. The reporting system is automatically generated by the procedure and saved in PDF format, the results from the model in the same structure can also be exported to other databases, like Excel or CSV files.

40.   The STAMP codes combine different MATLAB toolboxes. It is strongly recommended to purchase some licenses as soon as possible to avoid relying on temporary ones. The STAMP and the future version of the Thai model have an annotated code infrastructure that includes and combines MATLAB (2022b or older), DYNARE (version 4.5.4), the IRIS Toolbox (version 20200607), and the CompEcon Toolbox[7]. The DYNARE, IRIS Toolbox and CompEcon Toolbox are free software, and are available on the web, while it is strongly recommended to buy the MATLAB licenses as soon as it possible via the MathWorks. As a temporary solution, the scoping mission shared 2-month licenses with the FPO team.

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[7] DYNARE solves the dynamic equilibrium conditions and simulates the model, and it allows for the analysis of the dynamic properties of the model by exploring, for instance, the transmission mechanisms of various shocks and policies. The CompEcon Toolbox can be used to perform calibration and solve for the steady state in relatively complex models, for example due to involved interactions between heterogenous agents. Finally, the IRIS Toolbox helps visualize and report the model results in a hands-on reporting system. IRIS is efficient in saving the simulation results into consistent databases, or it can even export the results to other external software outside of the MATLAB, i.e., Microsoft Excel or other statistical software.

IV. CONSIDERATIONS FOR THE DESIGN OF THE ACTION PLAN

41.   The training sessions held during the scoping mission revealed a high potential for operating and interpreting a DSGE model in some participants. 14 FPO staff participated in the training, eight of which were from the DMP. None but one of these participants had previously been exposed to a DSGE model, but most of them had bachelor's or master's degrees in Economics. Overall, the assessment suggests areas for further development in staff's macroeconomic diagnostics and forecasting skills. However, the catch-up of some participants was quick, and most of them were able to manipulate the DYNARE codes of some basic DSGE models and identify key transmission channels of shocks in IRFs. This result is encouraging, and it very probably signals the viability of a DSGE tool for the FPO, as long as the engagement of the team is adequate and continuous.

42.   Releasing some core team members' daily work time for the project is a must for its success. Workload in the MMFS is high, with core tasks concentrated on 4-5 staff -most of which participated in the introductory training-. Given lack of previous experience with structural models and starting staff's capacity, customizing the STAMP and learning to operate it autonomously will beyond doubt take a significant toll in terms of the team's time. Moreover, for this effort to be fruitful, it should be carried out continuously, by letting staff dedicate 2-3 hours per day (approximately between 25% and 35% of their time) to activities within the project. As conveyed to FPO, DMP and MMFS management during the mission, this time will have large returns for staff and the FPO as organization, and it can only be considered a profitable investment. For that to be possible, it will be necessary to introduce the necessary changes in work organization in the concerned divisions to make this possible during their ordinary work schedule, without imposing too high a burden on their work-life balance and health. Beyond the timeframe of this project, the maintenance of the tool and its full incorporation to the FPO's analytical routines may warrant hiring additional staff.

43.   Keeping work momentum between missions will be an essential ingredient of capacity building. To make infused and continuous knowledge gains possible, a schedule of in-between virtual meetings will be introduced in the project. These will take place every two weeks, and serve two purposes: (i) presentation by all members of the core team, and subsequent discussion, of their proposed solutions to series of exercises/tasks provided by the ICD team; (ii) resolution of technical questions or difficulties the core team may find. The content of tasks can be adjusted during peaks of work at the FPO, but the discontinuation of these meetings would render the project infeasible.

44.   High staff turnover at the FPO is a critical risk of the project, and introducing incentives to the stability of the core group will be critical to avoid disruptions. As in the ministries of finance of many countries, high staff turnover is a structural characteristic of the Thai MOF, explained by compensation gaps with the private sector and different promotion schemes. To mitigate this risk, the core group will elaborate from the second mission, under the ICD team's guidance, a detailed documentation of the tool, including operational and analytical aspects. Still, a user manual does not entirely hedge the project against turnover risks, as new participants in the core group would face high entry costs upon their arrival. To fully address this issue, it will be important that both ICD and the FPO implement adequate incentives for the stability of the core group. In the ICD side, these could be, subject to adequate staff's performance in the project: (i) the organization of reverse missions to the Fund's HQ,

with the possibility of holding meetings with other department's staff and gain professional visibility; (ii) stays of some members in the core group in HQ, working on the model with the ICD's team support; (iii) selection of some members from the core group to participate in training courses organized by IMF regional training center, and (iv) the preparation of a working paper jointly between IMF staff and the core group members, to be published by the MOF, describing the functionalities of the model and analyzing specific scenarios. If turnover is unavoidable, the new team member should overlap with the departing member by at least four months to allow for appropriate onboarding, handover, and training.

45. **Composition of the core group**. The authorities were invited to present their nominations for the core group, giving due consideration to the requirements explained above. Regarding the size and divisional composition of the core group, the authorities were advised to weigh in some factors:

- <u>The number of participants in the introductory training seems too high for the core group</u>. Capacity of trainees was uneven, as well as their motivation to engage in discussions and effectively participate. Besides, an intermediate level of English would be a minimum requirement to develop a fluent communication with the ICD team. It should not be overlooked either that, the larger the number of participants, the more probable that issues with their dedication and time availability arise.

- <u>Participation of staff from different divisions has pros and cons</u>. The tool will be operated by MMFS staff, essentially the same team that operates the MAMUANG. Practically all members of this team participated in the training, and it would seem sensible that the core group is essentially made up by this staff because of the resulting synergies with forecasting activities. Expanding the composition of the core group to other relevant divisions of the DMP, or FPO divisions, could be beneficial from several points of view: (i) it could facilitate the consolidation of the tool in the FPO, and lay the ground for a diffusion of knowledge in other departments; (ii) it would enrich policy discussions within the core group when it comes to scenarios based on tax or expenditure reforms, or the customization of the fiscal block of the model. In that respect, potential complementarities in some extensions could be reaped with the Macroeconomic Analysis Section, also within the DMP, and both the divisions of Fiscal Policy and Tax Policy. There are also possible downsides, though, which could materialize if staff from other units do not have an adequate macroeconomic background of their engagement is not the same as MMFS staff's. An intermediate solution could be to designate a number of 'ad-hoc' members of the core group, which could participate in the design and interpretation of some policy scenarios.

46. **Because of the remaining knowledge gaps in macroeconomic diagnostic, the first missions of the project will emphasize a good conceptual grasp of the tool's economics.** Knowledge gaps are not so large to justify a full block of customized training in the work program, apart from the sessions provided in the scoping mission. That being said, the next 2-3 missions will gradually infuse the mathematical derivation of the model, while prioritizing an adequate understanding of agents' optimal behavior and policy rules, transmission mechanisms and basic code manipulation. This strategy should lower entry costs for the core group, highlight the attractions of the tool and incentivize an active involvement in its customization.

V.   ACTION PLAN

The following Action Plan has been agreed ad referendum with FPO Management.

Object of the project

47.   The project aims to build capacity in the FPO to customize, operate and integrate in policy analysis a simulation tool based on dynamic stochastic general equilibrium (DSGE) model. The tool will primarily be used for macroeconomic policy and structural analysis at the MOF, and will complement FOP's forecasting tools.

Beneficiaries of CD activities

48.   The project will be coordinated from the DMP of the FPO, and the tool principally operated by the Macroeconomic and Modeling Forecasting Section. This notwithstanding, it is expected that the whole MOF will be the direct beneficiary of this project, by means of the appropriate coordination arrangements within the FPO, and between Offices in the MOF.

49.   The authorities and the ICD team have agreed that the core group will comprise the permanent participants listed in Table 1 below. To elaborate this list, several criteria have been taken into consideration: (i) the background and experience of its members in those areas most closely related to the project; (ii) a substantial relation of the staff's assignments with the operationalization and/or the analytical exploitation of the tool; (iii) prospects of staff's stability at the FPO during the project and the period required for embedding the tool in the MOF's policy analysis system.

50.   The 6 participants strike an adequate balance between the above considerations. All of them belong to the Division of Macroeconomic Policy, 4 of them to the MMFS and 2 to the Innovation and Research Section, which is currently benefitting from the CGE project with the ADB. The ICD team also advices to maximize the participation, at least in some relevant sessions, of staff from other departments, such as the divisions of Tax Policy or Fiscal Policy when it comes to the design of tax reform scenarios.

Table 1: Participants in the core group

Name	Surname	Division	Position
Youthapoom	Charusreni	Macroeconomic Policy	Director of Macroeconomic Modeling and Forecasting Section
Chanon	Limpasitipon	Macroeconomic Policy	Economist, Professional Level (Coordinator)
Tanut	Puangnuam	Macroeconomic Policy	Economist, Professional Level
Kawin	Iamtrakul	Macroeconomic Policy	Economist, Professional Level
Ittipat	Prapaprasert	Macroeconomic Policy	Economist, Practitioner Level
Puttisombat	Pahnkul	Macroeconomic Policy	Economist, Practitioner Level

51.   Without prejudice to this list, other staff from relevant MOF departments can be invited on an ad-hoc basis to the CD sessions, to leverage their expertise in different types of macroeconomic and structural policies or macro-fiscal planning.

Structure of the project

52.   Table 2 below summarizes the delivery program. After the scoping mission, the DSGE model will be customized and calibrated in successive rounds, beginning in mission 2 and tentatively finalizing in mission 5. The starting point in mission 2 will be the canonical STAMP with a first calibration for Thailand. During that mission, the broad structure of the model will be presented to the core team, building on the general training delivered during the scoping mission. This first approach, together with an analysis of the steady state and properties of the model, will allow to identify key customization and recalibration needs. Priority will be given, in a first stage, to those customization elements that can be accomplished without large changes in the structure of the canonical model. Moreover, to the extent possible it will be considered to replicate some empirical properties of the Thai economy by means of combinations of shocks rather than major changes in the model.

53.   DMP's management feedback will be an essential ingredient of the customization process. At the end of the third mission, it is expected that the team makes a first presentation to FPO officials, showing some relevant properties of the model and benefitting from their views about possible improvements. A second presentation would take place during the fourth mission, this time highlighting the impact of key macroeconomic policy measures selected by the core team. A final presentation is scheduled by the end of the project, aimed at presenting a wide range of results with the final version of the model. Other presentations to external stakeholders are also included in the work program.

54.   During the customization phase, the team should develop a good grasp of the structure and transmission mechanisms of the model, as well as its calibration techniques. To that end, they will be asked to solve series of exercises, beginning by simple DSGE models that share some characteristics with the STAMP, and afterwards focusing on the customized model for Thailand. These exercises will include the derivation and linearization of some equations, calibration review, derivation of steady states, and the analysis of alternative scenarios. The results of these exercises will be presented both during in-between mission sessions and missions, and be followed by feedback from the project team.

55.   The integration of the tool in policy decision-making will receive major attention during the second half of the project, but it will already begin to be addressed during its first half. In this vein, the documentation of the model will start in the second mission, and continue as an integral element of every mission until the end of the project. By the same token, a reporting structure of results will be developed from the second mission. Likewise, the core group will work from the fifth mission on the integration of the DSGE outputs of key macro-fiscal reports and notes, published and internal. Lastly, subject to an

adequate performance, the work program contemplates the possibility of co-authoring a paper[8] with the core team during the second half of the project, to both solidify the skills built by the team and make the tool more widely known outside the FPO. In a central scenario this paper would be published by the MOF.

56.   The work program tentatively includes seven missions, including the scoping one that has just finalized. Delivery modalities would combine in-person and virtual CD. In-person missions will be frontloaded during the first half of the project, while those missions identified as virtual are, for now, purely indicative and to discuss with the team during CY2025. Subject to good performance of the core team, reverse missions could also be given consideration, with FPO staff traveling to the Fund's HQ. In-between mission engagements will always be virtual. To cover against possible contingencies, the work program also includes a 6-month 'buffer time' between June and November 2026, where additional activities could also be considered. The ICD team will discuss during CY2026Q1 the eventual need to utilize this buffer.

57.   Importantly, the effective length of the project depends to a great extent on the core group's efforts and progress. It could be expected that, the more time is regularly dedicated to working on the project, and the more continuous the group's engagement with the ICD team, the less time it should take to get positive results.

Table 2: CD activities during the project[1/]

Mission	Date	Content
Mission 1 (In-person)	November 2024	* Capacity and analysis system assessment * Training: conceptual introduction to DSGE models, economic foundations * Overview of STAMP characteristics and functionalities * Finalization of scoping draft report
In-between mission work	December 2024 - March 2025	* Series of exercises to be resolved by the core group, based on the presentations of mission 1 training * The core team identifies relevant time series for the calibration of big ratios and assessment of basic characteristic of the Thai economy. * Discussion on immediate customization needs continues.

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[8] The preparation of the working paper will be planned to ensure compliance with the Fund's publication policies.

Mission 2 (In-person)	March 2025	* Structure of STAMP: presentation of the linearized system of equations, structural assumptions and implicit transmission mechanisms. Review of big ratios and calibration criteria. * Analysis of the properties of the model with the first calibration, with emphasis on the fiscal balance and public debt path. Discussion of recalibration needs within the discussion about the characteristics of the Thai economy. * Presentation of a reporting infrastructure and automation of input data relevant to the model. * Definition of the information to include in the documentation of the tool[2/]
In-between mission work	March 2025 - June 2025	* The core group completes series of exercises on deriving and solving a simple general equilibrium model * Development and interpretation of scenarios with the homework model * Discussion of the detailed composition of policy packages to simulate during mission 3. Emphasis on fiscal policy reforms and policies to boost trend growth.
Mission 3 (In-person)	June 2025	* Presentation of the second version of the model based on the decisions made in the previous mission. Study of the properties of the recalibrated version of the model. * Simulation of policy packages proposed by the core group. Distillation of conclusions and preparation of a narrative. * Preparation of an internal presentation for DMP management based on the second version of the model and preparation of a narrative for scenarios. * Presentation to management and discussion of feedback. Stocktaking of possible recalibration or customization needs.
In-between mission work	May 2025 - September 2025	* The core group completes work on reporting and policy scenarios with the second version of the model. * Core group members exercise themselves in the design and explanation of scenarios reflecting relevant economic phenomena. * The core group presents its proposed recalibration for a number of parameters, based on a compilation of empirical studies or analyses of their own. * The core group replicates the derivation of some selected parts of the model.
Mission 4 (virtual)	September 2025	* Analysis of the properties of the third version of the model * Preparation and delivery of a presentation to DMP and DFP management that assesses relevant policy measures through the second version of the model. * Stocktaking of recalibration and extension needs. * Discussion on options for an integrated narrative for baseline projections and alternative scenarios. * Discussion on possible ways to integrate alternative scenarios produced with the model in internal and external reports produced by FPO, and analytical discussions with the NESDC[3/]. Identification of further customization needs in the reporting infrastructure.

In-between mission work	September 2025 - December 2025	* The core group continues the works on refining the model. * Further practice with the derivation of some parts of the model. * The core group conducts a series of exercises to integrate shocks simulated in model into its baseline forecast. * Adjustments in the reporting infrastructure.
Mission 5 (In-person)	December 2025	* Finalization of the model based on the feedback from the previous mission, management and policy questions. * Additional hands-on practice to introduce the outcomes of simulated shocks and policy measures as alternative scenarios to baseline projections. * Introduction of changes in the reporting infrastructure. The team begins the preparation of some alternative scenarios and their narrative in the DMP's briefings and/or the fiscal risk statement[4/]. * Discussion on the structure of a publication co-authored by the team on the final version of the model calibrated for Thailand[5/.]
In-between mission work	December 2025 - March 2026	* The core group starts drafting the paper. * The core group continues the preparation of sections for the DMP Briefings and/or fiscal risk statement.
Mission 6 (Virtual)	March 2026	* Technical presentation of the functionalities of the tool to the PDMO and other remaining divisions within the FPO.[9] * In view of the above presentations, discussion on possible improvements in the reporting system or discussion of the tool's outputs to ensure its relevant role in policy-making decisions. * Preparation of updated scenarios in view of the policy priorities for next fiscal year. * The team concludes the relevant sections of the fiscal risk statement, and develops prepares material for the presentation of alternative scenarios in the FPO, together with its baseline projections. * Drafting of the paper continues
In-between mission work	March 2026 - June 2026	* Paper drafting continues * The core team designs a reporting structure for presentation of the tool results to the NESDC and elaborates a calendar for the utilization of the tool. * Last round of exercises on shock for discussion with management.
Mission 7 (In-person)	June 2026	* Final presentation to management and other divisions of the FPO of the refined outputs of the tool and pilot report * Finalization of the model documentation * Finalization of the draft paper * Wrap-up and delivery of the end-project report

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[9] Subject to the FPO authorities' agreement, during the last missions of the project it would also be very recommendable to set up some presentations on the functionalities of the tool to the NESDC and BOT, given the major role of these agencies in the forecasting and policy analysis system.

Buffer time	June 2026-November 2026	* Resolution of additional difficulties in the operation of the tool * Follow-up on the integration of the tool in the policy analysis systen * Possible additional missions

1/ The modality of missions (in-person vs. virtual) is for now indicative.
2/ Preparation of the model documentation will start in mission 2 and continue until the end of the project.
3/ Most relevant reports would the Fiscal Risks Statement, and internal documentation for presentations of projections within the FPO and multi-annual projection discussions with the NESDC.
4/ Inclusion of the tool outputs in the Fiscal Risk Statement is subject to the agreement of the Division of Fiscal Policy, tasked with the coordination of this document.
5/ The preparation of this paper, to be published by the MOF, would be subject to an adequate performance and progress by the team.

Commitments of the authorities

58.   In order to promote the continuous engagement of the core group, ensure a sufficient staff's dedication to the project and minimize the risk of disruptions, FPO Management commits to:

1. Ensuring that core group members are able to devote **at least 25 per cent of their standard working time**, on a daily basis, to those activities directed to build their technical capacity within the project. Other ongoing or future TA projects in which core group members participate should not detract from this minimum time.

2. Promoting the active participation of the core group members in missions and in-between mission follow-up meetings every two weeks.

3. Incentivizing the stable participation of the core group members in the whole project and the consolidation of the tool in the FPO. In case of core group's members turnover, authorities shall grant a minimum 4-month overlap of the new group member with the exiting one, to facilitate the training of the former.

4. Ensuring that MATLAB licenses are available to the core group during the whole project and beyond, to allow for the operation of the tool.

Risks of the project

59.   Two main risks have been identified during the scoping mission, although the mutual commitments agreed in this Action Plan are expected to effectively mitigate them:

- **Insufficient time availability for staff.** A high workload could compromise an adequate dedication to the project by the core group.

  Mitigation measures: (i) The authorities' commitment to creating space for the participating staff should largely neutralize this risk; (ii) The selection of core group members with the right background should also reduce the possibilities of inefficiently large time requirements to meet the project's needs.

- **High staff turnover**. Entry costs to a project of these characteristics could be high for new staff, and the replacement of core group members result in considerable delays of the project.

  Mitigation measures. (i) The tool documentation should steadily advance during the project, with specific time slots in each mission and in-between mission follow-ups allocated to the review of material; (ii) The selection of staff for the core group rest on their motivation and professional closeness to the tool; (iii) The work program includes some possible incentives to discourage turnover, such as the publication of the paper or staff's stays and reverse missions at HQ[10]; (iv) It is in FPO's direct interest to consolidate a solid human capital in the wake of this project, and Management is encouraged to consider possible incentive schemes to retain as much as possible the most capable staff.

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[10] At could also be considered the participation of core group members in related trainings and courses delivered in HQ or the Fund's regional centers. For example, DSGE courses when available.

ANNEXES

ANNEX 1: LOGFRAME OF THE PROJECT

Objective: Develop capacity in macroeconomic forecasting and policy analysis to support policy decision making and communications - MFR			
Outcome: Analytical models and forecasting tools are developed and operational			
Annual Assessment Rating: 1 Not Achieved			
Outcome Rating Date: 12/2/2024			
Outcome Indicator	**Baseline Value**	**Target Value**	**Current Assessment Value**
Macroeconomic Projection Tool (MPT) is developed in the form of a fully structural DSGE model	1	4	1
Milestone Name	**Target Completion Date**	**Milestone Actual Completion Date**	**Milestone Rating**
DSGE structure is customized to account for the specific characteristics of the Thai economy	12/31/2025		1 Not Achieved
DSGE calibration is completed	3/31/2026		1 Not Achieved
A standardized reporting structure for the tool's outputs is developed	9/30/2024		1 Not Achieved
Outcome: Improved analytical skills, and better macroeconomic forecasting and policy analysis capacity			
Annual Assessment Rating: 1 Not Achieved			
Outcome Rating Date: 12/2/2024			
Outcome Indicator	**Baseline Value**	**Target Value**	**Current Assessment Value**
Relevant staff demonstrates the capability to independently operate the MPT and other auxiliary analytical models and tools	1	4	1
Milestone Name	**Target Completion Date**	**Milestone Actual Completion Date**	**Milestone Rating**

Core team members demonstrate their ability to produce several policy and shock scenarios in with the tool	9/30/2025		1 Not Achieved
Core teams are able to provide an economic narrative to policy and shock scenarios, and relate outcomes with the structural characteristics of the Thai economy	12/31/2025		
Core team members demonstrate their ability in maintaining, updating and customizing the DSGE model	6/30/2026		1 Not Achieved
Core team presents the DSGE model to its management, and show its functionalities for policy scenario analysis	12/31/2025		1 Not Achieved
Core team conducts a pilot integration of DSGE outputs into its analytical report system	6/30/2026		1 Not Achieved
Documentation of the DSGE model is finalized	6/30/2026		1 Not Achieved

Outcome:
Authorities have a baseline understanding of their forecasting and analytical capabilities and opportunities for improvement

Annual Assessment Rating: 4 Fully Achieved

Outcome Rating Date: 12/2/2024

Outcome Indicator	Baseline Value	Target Value	Current Assessment Value
Diagnostic or scoping has produced baseline and opportunities for improvement	1 No diagnostic in place	4 An action plan for improvement has been elaborated and agreed with the authorities	4
Milestone Name	**Target Completion Date**	**Milestone Actual Completion Date**	**Milestone Rating**
Authorities discuss the capacity assessment with the scoping mission team and agrees on an action plan	11/30/2024	11/26/2024	4 Fully Achieved

1/ This logframe is only provisional, pending the capacity assessment and discussions with the authorities in the upcoming mission.

ANNEX 2: MISSION AGENDA

Time Monday, November 18	Counterpart	Topics for discussion
9 am - 12 pm	Fiscal Policy Bureau	1. Presentation and objectives of the mission 2. Overview and functionalities of the STAMP model 3. Intended uses of the DSGE 4. Existing simulation toolkit - Coordination with external stakeholders on simulation work and policy assessment 5. Internal databases: structure and management practices
3.30 pm - 5.30 pm	Bank of Thailand	1. Introduction and objectives of the mission 2. Overview of the simulation toolkit of BOT 3. The DSGE model: latest version and properties 4. Integrated fiscal policy analysis in the semi-structural model, with especial attention to the impact of fiscal policy 5. Areas of analytical collaboration with the MOF
Tuesday, November 19		
9 am - 12 pm	Core group	Training (I): DSGE models - overview Basic real business cycle model Key building blocks of the model in Dynare IRFs
12 pm - 1.15 pm	Lunch	
1.15 pm - 3.15 pm	Core group	Training (I): DSGE models - overview Basic real business cycle model Key building blocks of the model in Dynare IRFs
3.30 pm - 5.30 pm		Session on the core forecasting model
Wednesday, November 20		
9 am - 12 pm	Core group	Training (II): Economic foundations of standard New Keynesian models. Households, firms and price setting behavior. The Phillips curve
12 pm - 1.15 pm	Lunch	
1.15 pm - 3.15 pm	Core group	Training (II): Economic foundations of standard New Keynesian models. Households, firms and price setting behavior. The Phillips curve

3.30 pm - 5.30 pm		Session on database and calendar of projections
Thursday, November 21		
9 am - 12 pm	Core group	Training (III): Economic foundations of standard New Keynesian models. Labor market rigidities and monetary policy. Illustrative shocks
12 pm - 1 pm	Lunch	
1.15 pm - 4 pm	Core group	Training (III): Economic foundations of standard New Keynesian models. Labor market rigidities and monetary policy. Illustrative shocks
Friday, November 22		
9 am - 12 pm	Core group	Training (IV): Economic foundations of standard New Keynesian models. External sector
12 pm - 1 pm	Lunch	
1.15 pm - 3.15 pm	Core group	Training (IV): Economic foundations of standard New Keynesian models. Fiscal policy
1.45 pm-2.45 pm	Public Debt Management Office	Debt projections and risk analysis
3.15 pm - 4.15 pm	Macroeconomic Policy Bureau	Preliminary discussion of the project work program
Monday, November 25		
9 am - 11 am	Core group	Training (V): Economic foundations of standard New Keynesian models. Fiscal policy (cont.).
11 am - 12 pm	Core group	Training (V): Illustrative shocks in the STAMP model. Analysis of transmission channels
12 pm - 1 pm	Lunch	
1.15 pm - 4 pm	Core group	Training (V): Illustrative shocks in the STAMP model. Analysis of transmission channels
Tuesday, November 26		
9 am - 11.30 am	Core group	Discussion: Characteristics of the STAMP in the context of the Thai economy. Feedback from the core group
11. 30 am - 12 pm	Core group	Work assignments - Calendar for in-between mission meetings
12 pm - 1.30 pm	Lunch	
1.30 pm - 2.30 pm	Macroeconomic Policy Bureau	Agreement on the work program and delivery of the draft report

Name	Surname	Bureau	Position
Youthapoom	**Charusreni**	Macroeconomic Policy	Director of Macroeconomic Modeling and Forecasting Division
Chanon	**Limpasitipon**	Macroeconomic Policy	Economist, Professional Level
Tanut	**Puangnuam**	Macroeconomic Policy	Economist, Professional Level
Kawin	Iamtrakul	Macroeconomic Policy	Economist, Professional Level
Thanaphon	Karnnowvakun	Macroeconomic Policy	Economist, Professional Level
Ittipat	Prapaprasert	Macroeconomic Policy	Economist, Practitioner Level
Piyapat	Preehachinda	Macroeconomic Policy	Economist, Practitioner Level
Kittikun	Chumworathayee	Macroeconomic Policy	Economist, Practitioner Level
Sanhanat	Satetasakdasiri	Fiscal Policy	Economist, Professional Level
Nanthawat	Ouysinprasert	Fiscal Policy	Economist, Practitioner Level
Chitraporn	Amrapala	Tax Policy	Senior Economist
Pinyapasorn	Puangjik	Tax Policy	Economist, Practitioner Level
Phandia	Pruchayakul	International Economic Policy	Economist, Professional Level
Kulprapa	Ketkaew	Saving and Investment Policy	Economist, Practitioner Level