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A Monetary and Financial Policy Analysis and Forecasting Model for the Philippines

(PAMPh2.0)

Francisco G. Dakila Jr., Dennis M. Bautista, Jasmin E. Dacio, Rosemarie A. Amodia, Sarah Jane A. Castañares, Paul Reimon R. Alhambra, Charles John P. Marquez, Jan Christopher G. Ocampo, Mark Rex S. Romaraog, Philippe Karam, Daniel Baksa, Jan Vlcek

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ABSTRACT: The Bangko Sentral ng Pilipinas (BSP) has enhanced its macroeconomic modeling through the Forecasting and Policy Analysis System (FPAS), transitioning from a multi-equation econometric model to a modernized system centered on the Quarterly Projection Model (QPM). In its new version, the Policy Analysis Model for the Philippines (PAMPh2.0) integrates forward-looking projections, endogenous monetary policy, fiscal and macroprudential considerations, labor dynamics, and addresses complex shocks and policy trade-offs, facilitating effective policy mix determination and supporting real-time policy evaluation. The BSP's modernization efforts also include refining forecast calendars and strengthening communication channels to accommodate the operationalization of PAMPh2.0. Detailed validation methods ensure empirical consistency. Finally, future refinements will align the model with evolving empirical findings and theoretical insights, ensuring its continued relevance.

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Contents

1. Introduction

The Bangko Sentral ng Pilipinas (BSP) is upgrading its framework for macroeconomic modeling through the Forecasting and Policy Analysis System (FPAS). While relying on a multi-equation econometric model (MEM), the BSP leans toward a modernized FPAS with a semi-structural Quarterly Projection Model (QPM) at its core in response to the increasing complexity of its operating environment amid global supply shocks in a small open economy particularly vulnerable to sudden and large swings in capital flows and exchange rate volatility. The extended QPM[1], known as the Policy Analysis Model for the Philippines, version 2.0 (PAMPh2.0) offers forward-looking projections with endogenous monetary policy and extends to include fiscal policy, macrofinancial linkages, labor dynamics, and additional tools like FX interventions. The full operationalization of the model, as this paper will show, could significantly enhance policymakers' real-time evaluation of decisions, especially in navigating a complex macro-financial landscape, fostering integrated thinking about trade-offs between different policy tools and supporting coordination among the different policies that could foster improved interdepartmental cooperation within the BSP.

The collaborative efforts between the IMF and BSP, facilitated by ICD-led technical assistance (TA) since Spring 2022, have been dedicated to the development and modernization of PAMPh2.0 for its adoption as the BSP's core medium-term forecasting model. Throughout the TA project, extensions were incorporated gradually, achieving significant milestones such as "conditional forecasting," preparation and presentation of shadow or mock forecasts (in parallel or ahead of actual, real-time forecasts), and conducting scenario analyses. The continuous enhancement of models and tools has proven invaluable in effectively navigating complex situations, requiring a delicate balance among policy trade-offs and objectives.

The BSP's modernization effort will extend beyond the core model, implementing reforms for crucial elements of the modernized FPAS. This shall encompass refining the forecast and monetary policy meeting calendar, establishing effective interdepartmental and vertical communication with senior management to facilitate policy deliberations and other system-wide improvements. These efforts are particularly significant in the context of the new PAMPh2.0 and the associated complexities of communication within a multi-policy environment. A clear plan outlining activities leading to the formal adoption of PAMPh2.0 is underway.

The BSP has embarked on enriching its first QPM in response to a new environment characterized by complex and interrelated fundamental and non-fundamental shocks. These included the impact of COVID-19 shocks, Ukraine and commodity price shocks post-COVID-19, global interest rate (Fed tightening) shocks, and destabilizing risk premia and global investor sentiment shifts. It has sought to assess quantitatively how these shocks interact with frictions and characteristics inherent to the Philippines, including financial imperfections like FX market depth and occasionally-binding external debt limits as well as domestic market imperfections and credit channels, to better tailor its policy response. For example, in evaluating risks to anchored inflation expectations, BSP staff has analyzed the impact of exchange rate shocks and supply shocks and conducted policy simulations within the framework of PAMPh2.0. The latter has also encompassed the role of fiscal and macroprudential policy reaction functions to support a coherent monetary and exchange rate regime, while also exploring labor market-wage-related issues, and climate-change considerations.

[1] The original basic QPM or PAMPh v1.0 (Policy Analysis Model for the Philippines) is described in Alarcon et al. (2021).

PAMPh2.0, drawing inspiration from the recently published extended QPM FINEX (Berg et al., 2023), stands out as a state-of-the-art, open-economy New Keynesian general equilibrium model. Inspired by the Integrated Policy Framework (IPF) by the IMF, it explicitly incorporates crucial macro-financial channels, following the microfounded portfolio balance approach by Gabaix and Maggiori (2015).[2] Although not explicitly categorized as a friction-based, welfare-optimizing framework, PAMPh2.0 analyzes a range of policy tools, extending beyond traditional monetary and fiscal policies to include non-traditional tools such as foreign exchange intervention (FXI), capital flow management measures (CFMs), and macroprudential measures (MPMs). Further, operating within a consistent and systematic policy framework tailored for the Philippines, PAMPh2.0 facilitates the analysis of trade-offs and the determination of efficient policy mixes. Emphasizing its integrated monetary and financial nature, PAMPh2.0 serves as an advanced forecasting model, primarily designed for baseline forecasts, risk analysis, policy scenarios, and simulations. The model, aligning with the operational approach of central banks worldwide, including both advanced economies (AE) and EMDEs,[3] emphasizes reliability and operational efficiency, structured into modules that are straightforward to follow and implement. Acknowledging the importance of clear interpretation, PAMPh2.0 has been specifically designed to simplify the understanding of shocks, generate policy-dependent forecasts, and effectively communicate economic narratives related to forecasts and alternative scenarios.

In asserting its validation, three forecast evaluation methods for PAMPh2.0 have been considered. To begin with, the decomposition of changes in consecutive forecasts, particularly applied in different shadow forecasts, has aimed at enhancing understanding and explanation of forecast variations to policymakers. This could address their interest in discerning how the current forecast differs from the previous one, identifying key drivers, and understanding implications for policy recommendations. Meanwhile, the validation exercise comparing historical forecasts with actual data, while critical, can only be conducted in the future when at least a year’s worth of historical quarterly forecasts are collected, and more elaborate databases are developed. Nonetheless, preparations for such an evaluation are already underway.[4] The aim is to create a robust model that fits the Philippines empirical evidence while maintaining theoretical and macroeconomic consistency within its monetary regime.

Addressing challenges in adopting PAMPh2.0 involves managing communication associated with multiple channels and trade-offs in constructing a narrative for a complex policy mix. Through its consistent framework, PAMPh2.0 can offer a solution in effectively communicating the use of policy tools within more complex regimes. Another hurdle is integrating policies working on different time frames and frequencies, affecting various parts of economic cycles. Coordination challenges also arise as BSP’s departments operate independently, emphasizing the need for integrated views from different departments, guided by the BSP's Advisory Committee (AC) on Monetary Policy and Monetary Board. Additionally, assessing the size and nature of shocks in real-time presents a critical challenge, suggesting the use of preventive policies (e.g., MPMs) to maintain macro-financial stability. In its effort to foster ownership and draw feedback at an early stage,

[2] For example, in reference to key IPF frictions (UIP premia distortions, FX mismatches, unanchored inflation expectations), the underlying destabilizing effects are concerns that have been addressed in the context of structural and semi-structural models to different degrees, following different approaches.

[3] PAMPh2.0 acknowledges other types of models which focus on similar objectives of policy analysis and forecasting—for e.g., DSGE-type models for these purposes. See Maehle et al. (2021) and Berg et al. (2023) for a comparison of models broadly; and the Philippines, for comparing the two types as pertaining to the Philippines (IMF 2023b).

[4] A statistical evaluation of forecasts involves computing statistical characteristics like bias and RMSE during the early stages of forecasting with PAMPh. Recognizing the conditionality of PAMPh forecasts on the policy interest rate, deviations from actual data may result, primarily affecting the near-term horizon. However, such deviations do not need to be interpreted as model imprecisions but rather deviations caused by different monetary policy response.

PAMPh2.0 dissemination both internally and externally[5] has helped further clarify calibration methods, labor and wage dynamics under persistent inflation, model property validation, prioritization of different models' use for regular forecasting, and better integration of policy and operational frameworks.

Collaborative efforts have effectively addressed crucial gaps, establishing PAMPh2.0 as the preferred core model for policy deliberation at the time of this paper's publication. Any remaining gaps are not anticipated to significantly impede the operationalization and adoption of PAMPh2.0 in both policy setting and communication. However, being a dynamic model, PAMPh2.0 is expected to undergo future refinements to align with evolving theoretical thinking and empirical findings. With the BSP staff having acquired the necessary skills, the model is well-positioned for refinement and adaptation in response to significant developments in the foreseeable future. Looking ahead, the formal adoption of PAMPh2.0 creates additional opportunities to develop and institutionalize coordination among the monetary, financial supervision, and macroprudential sectors. In its extended form, PAMPh2.0 could serve as a very useful tool for technical staff and policymakers to assess initial conditions and assumptions, quantify policy effects and alternative scenarios, understand trade-offs, ensuring that policy decisions align with the BSP's long-term objectives.

In the subsequent sections, we delve into the details. Section 2 delineates the essential stylized facts of the Philippines, crucial for motivating the structure of PAMPh2.0 by offering an interpretation of recent economic developments and policy preferences. Readers well-versed in the economy's structure may opt to bypass this section and proceed directly to the next. Building upon this foundation, Section 3 provides an overview of the model structure and its integration within a broader suite of evolving models. Moving forward, Section 4 presents a comprehensive analysis of the dynamic and empirical properties of PAMPh2.0, employing various analytical tools such as impulse response analysis, historical simulations, and an assessment of in-sample forecasting performance. This section also underscores the role of calibration and estimation methods. Lastly, Section 5 encapsulates the primary findings, challenges, and outlines the steps for future advancements.

[5] The model features and structure of PAMPh was presented during the 61st Philippine Economic Society Annual Meeting and Conference on 7 November 2023.

Box 1. Multi-Phase Technical Assistance Proceedings

The modernization of the BSP's Policy Analysis Model for the Philippines (PAMPh) is a multi-year collaboration between the IMF Institute for Capacity Development (ICD) and the BSP Department of Economic Research (DER). Phase 1 of the Technical Assistance (TA) started with first on-site mission in April 2022 aimed to build upon the initial version of PAMPh, focusing on reviewing its features and forecasting performance.

The second phase of the mission, conducted in October 2022, detailed decomposition of aggregate demand, external, and fiscal sectors was introduced, enabling quantification of the model's transmission channels and interlinkages of its different policy instruments to effectively communicate different policy trade-offs. This phase concluded with a meeting discussing challenges, risks, and opportunities with the Governor and members of the Monetary Board to strengthen the BSP's policy frameworks.

The subsequent TA mission in March 2023 focused on further enhancing PAMPh's calibration and storytelling capacity. The mission also introduced further extension to the model by developing a systematic assessment of its forecasting performance. Initial discussions commenced on institutional changes necessary for PAMPh's planned adoption as the BSP's workhorse model for monetary policy analysis and forecasting.

In July 2023, the fourth phase of the TA incorporated credit cycle dynamics in the Philippines, focusing on macrofinancial linkages and the role of macroprudential policy in achieving economic and financial stability. Capital flow management measures were also added to the model during this phase, analyzing its impact on exchange rate dynamics and monetary conditions, and interactions with other policies. The mission concluded with discussions on future steps for PAMPh with senior management.

In February and March 2024, the TA mission completed phase five by extending the PAMPh model to incorporate the labor block. During this phase, the DER-EFFG and ICD TA team addressed BSP senior management's concerns regarding model structure, market interest rate, policy rule calibration to align with senior management's preferences, supply shock treatment, and inflation expectations. The mission concluded with a presentation led by DER-EFFG to the BSP Monetary Board and Advisory Committee on Monetary Policy, covering model issues raised by senior management, PAMPh-based shadow forecasts, and assessment of alternative scenarios.

2. Stylized Facts from the Philippines and Model Motivation

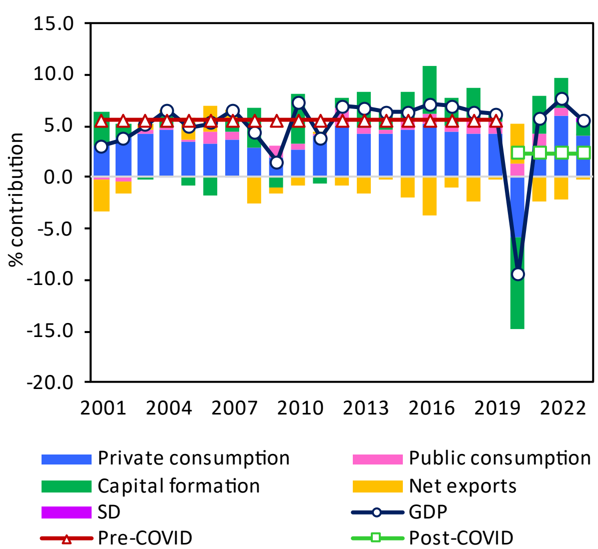
To ensure its relevance in macroeconomic policy analysis and monetary policy formulation, PAMPh2.0 incorporates the crucial stylized facts of the Philippine economy, closely aligning with the BSP's policy framework. Acknowledging the policy significance of integrating country-specific features into the analytical framework, this section outlines the stylized facts of the Philippines that drive specific deviations from a standard QPM and the need to complement traditional policies with non-traditional ones. These adaptations aim to enhance the model's structure and properties, with detailed explanations provided in Sections 3 and 4.

2.1 GDP and Expenditure Side Decomposition

Over the past two decades, the Philippine economy has grown at an average of 5.0 percent from 2001 to 2023. It experienced accelerated economic growth in the mid-2000s, propelled by robust domestic demand (Figure 2.1) and favorable global conditions. The global financial crisis (GFC) in 2008-2009 led to temporary setbacks, with GDP growth slowing to 1.4 percent in 2009. Following the GFC, GDP rebounded strongly, growing at 6.4 percent from 2010 to 2019, with over 6.0 percent growth sustained for eight consecutive years starting in 2012. Private consumption, investment, and public consumption all made steady contributions to growth. The resilient services and industry sectors (Figure 2.2) played a significant role, accounting for approximately 90 percent of the economy's performance. The output gap was generally positive during this period particularly in 2018-2019 (Figure 2.3). Growth was later interrupted by the significant contraction in 2020 due to the COVID-19 pandemic.

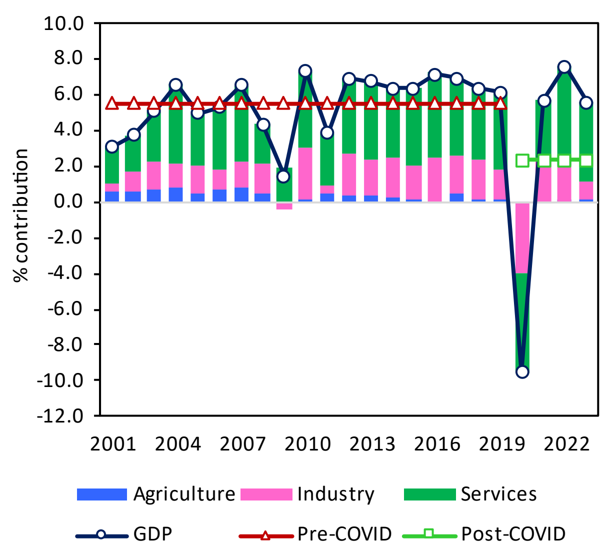
From 2021 to 2022, a calibrated reopening of the economy, coupled with a favorable global economic landscape, government policy support, and structural reforms, spurred a strong recovery in the Philippines. The services sector emerged as the primary driver of this recovery on the supply side, benefitting from relaxed mobility restrictions, the resumption of face-to-face classes, and eased travel protocols. On the demand side, growth was observed in household and government expenditures, as well as in investments, fueled by increased mobility of people, goods, and services due to further relaxation of COVID-related quarantine measures, sustaining economic growth.

Figure 2.1: Contribution to growth, expenditure side



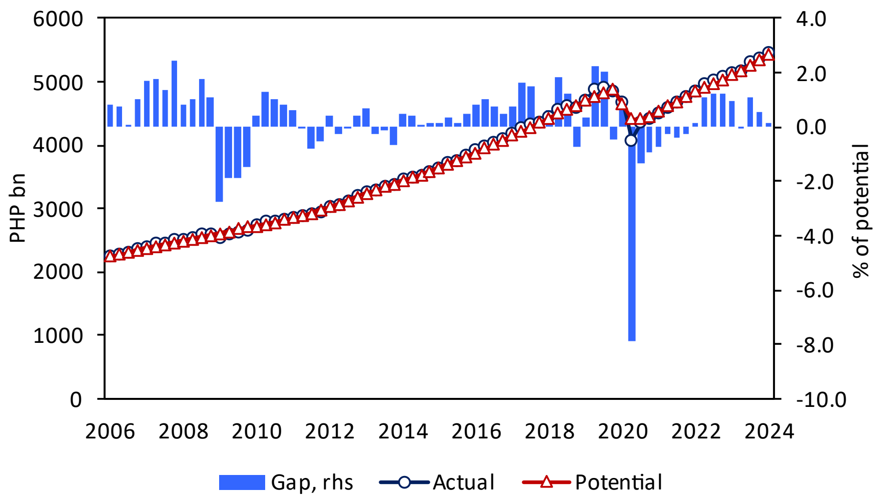
Data source: PSA

Figure 2.2: Contribution to growth, production side



Data source: PSA

Figure 2.3: Output gap



Source: Staff computations

2.2 Labor Market and Wage Developments

Before the COVID-19 pandemic, the Philippines witnessed its longest economic and job growth period. Not only did employment numbers rise significantly, but job quality, measured by the increase in wage and salary workers, also showed a steady annual growth rate of 4.6 percent from 2015 to 2019 (Figures 2.4 and 2.5). However, the pandemic reversed these gains, leading to the loss of 1.7 million wage and salary jobs by January 2021. With the easing of quarantine measures, labor market gradually improved in 2022, with unemployment rates dropping to their lowest point since the peak of the pandemic.

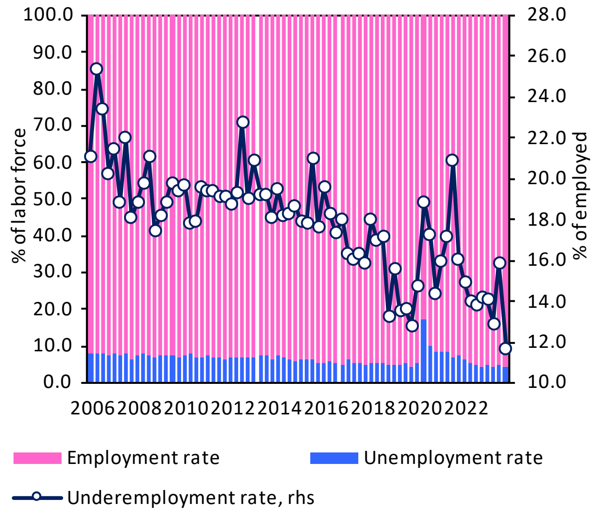
Nevertheless, labor quality was late to improve as sustained growth in wage and salary workers only became evident beginning in 2023. In the interim, average daily pay[6] has kept pace with the daily minimum wage, with both measures experiencing an average growth rate of 4.5 percent from 2005 to 2012. However, since 2013, the growth of average daily pay has accelerated to 5.4 percent, while the growth in minimum wage has slowed down to 3.0 percent. Adjusting for inflation, average daily pay grew marginally by 0.2 percent in 2023, significantly lower than its 10-year average of 1.9 percent. Meanwhile, real minimum wage increased by 1.3 percent last year, significantly higher than its 10-year average growth of -0.2 percent, reflecting the series of wage increases over the past year which aims to restore purchasing power among the minimum wage earners (Figure 2.6).

This analysis is supplemented by the Labor Utilization Composite Index (LUCI), which offers an overview of the labor market situation in the Philippines (Figure 2.7). It combines data from nine labor market variables[7] using the principal components method. LUCI estimates indicate a significant loosening of the labor market in 2020-2021, but gradual improvement has been observed since Q1 2022. Estimates for Q4 2023 show sustained enhancement in the LUCI, signaling a positive shift in the current labor market conditions, which may potentially lead to inflationary pressures in the upcoming quarters.

[6] Average basic daily pay is the pay for normal time, prior to deductions of social security contributions, withholding taxes, and others. It excludes allowances, bonuses, commissions, overtime pay, and benefits in kind.

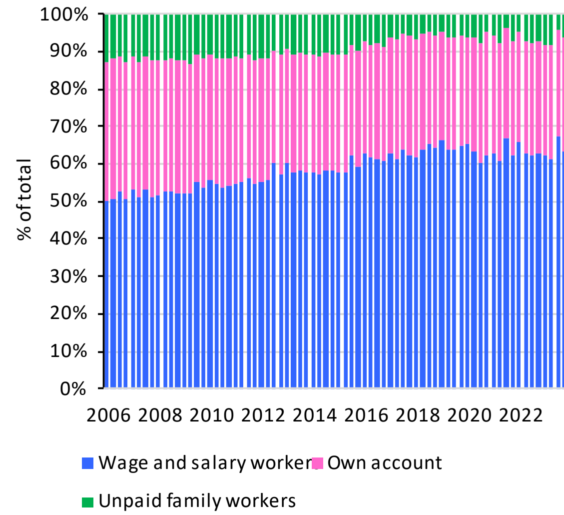
[7] The time series include the size of the adult population, number of employed, underemployed, visibly underemployed, wage and salary workers, unpaid family workers, weekly mean hours worked, real minimum wage, and real average basic daily pay.

Figure 2.4: Employment indicators



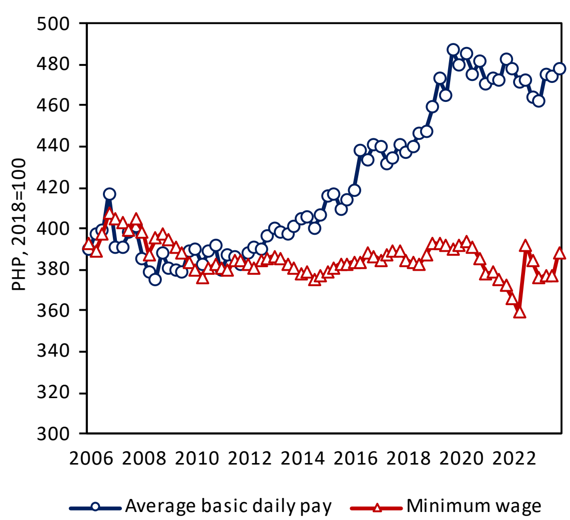
Data source: PSA

Figure 2.5: Employment by class of workers



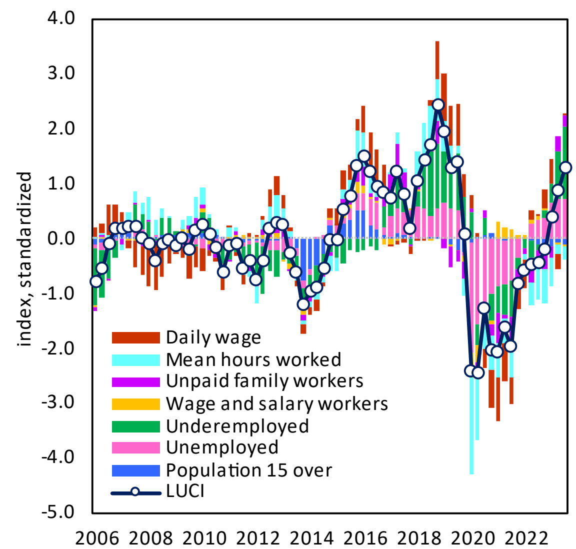
Data source: PSA

Figure 2.6: Real daily wages



Data source: NWPC, staff computations

Figure 2.7: Labor utilization composite index



Data source: Staff computations

2.3 Prices: Core and Non-Core Subcomponents

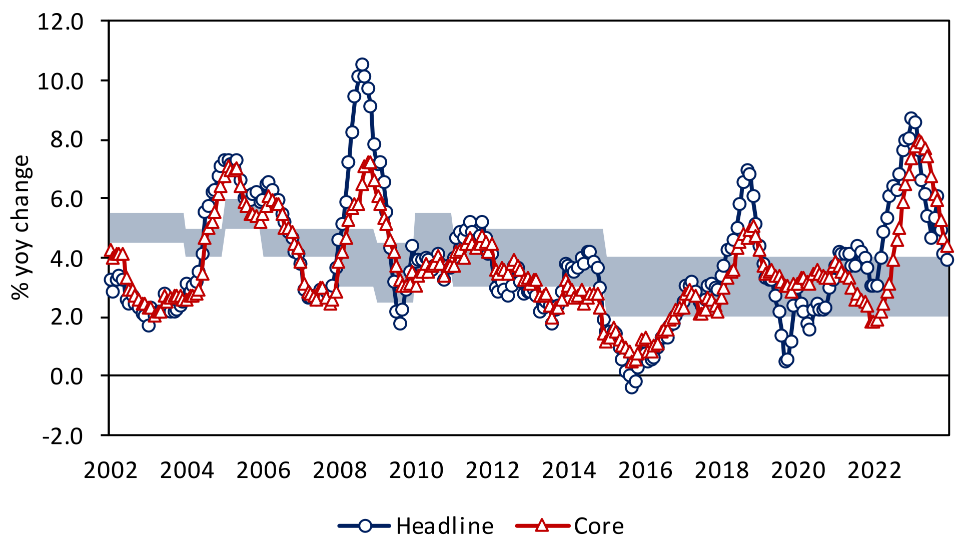
In the initial years since the adoption of the IT framework from 2002 to 2009, headline inflation settled above the target range in four out of eight years, below the target range for three years and within the target range once (Figure 2.8). Periods of below-target inflation were usually driven by easing global and domestic food and oil prices. Meanwhile, periods of above-target inflation were affected by supply-side shocks from higher global oil prices and second-round effect on transport fares, adverse impact of weather conditions such as *El Niño* on domestic food production, and implementation of higher value-added tax (VAT) and excise taxes.[8]

The period after the GFC was characterized by low and stable inflation and strong domestic economic activity. GDP growth expanded above the historical trend at 6.5 percent from 2010 to 2017. Nonetheless, implementation of government structural reforms, together with enhancements in the BSP's monetary policy framework, helped bring inflation slightly below 3.0 percent.

Guo et al., (2019) reported a significant inflation spike in 2018 attributed to various supply-side factors, including surges in global crude oil prices, increased domestic excise taxes on oil and "sin" items, and elevated domestic rice prices due to restricted import quotas. Concurrently, demand-side pressures were evident with the rise in services inflation, coinciding with the slightly positive output gap estimated for the period leading to 2018.

In the subsequent years (2019-2020), headline and core inflation decelerated, returning to within the target range, primarily due to lower food and energy prices. Food inflation moderated as supply conditions improved, aided by structural reforms like the implementation of the Rice Tariffication Law (RTL), which led to decreased rice prices. Additionally, the easing of energy prices in 2019 and at the onset of the pandemic in 2020 contributed to maintaining inflation within the target range.

Figure 2.8: Consumer price inflation



Data Source: PSA

In 2021, headline inflation began to rise, driven by increased food and energy inflation (Figure 2.9). Food inflation was primarily fueled by domestic supply constraints on key food items such as meat, exacerbated by the African Swine Fever outbreak and adverse weather conditions affecting fish production. Energy inflation escalated as the global economy gradually re-opened from pandemic-induced lockdowns. Concurrently, core

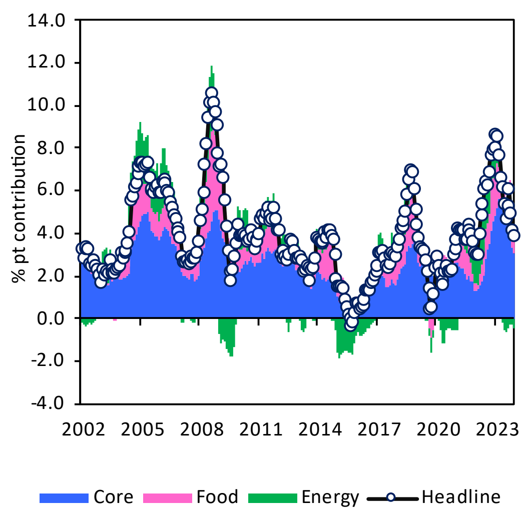
[8] Supply-side shocks include shocks to inflation expectations, which can be assessed by referring to Figure 4.13 for a historical shock decomposition and its contribution to inflation dynamics.

inflation slowed down due to the lingering effects of the pandemic on the output gap, leading to deceleration in both core goods and services inflation (Figure 2.10).

In 2022 and 2023, inflation surged, averaging 5.8 percent and 6.0 percent, respectively, driven by consecutive supply-side shocks and ensuing second-round effects. Escalating oil and fertilizer prices, stemming from the Russia and Ukraine conflict, significantly raised domestic energy costs. Persistent weather disruptions affecting key food supplies also contributed to inflation pressures. Additionally, second-round effects, including transport fare hikes, electricity adjustments, and higher minimum wages, fueled core inflation in both years.

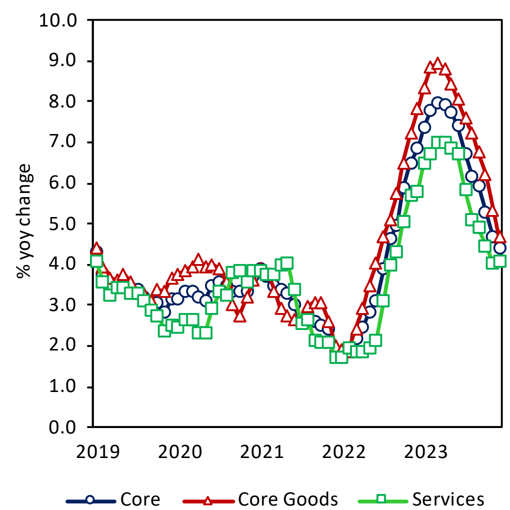
The trends in relative prices indicated that the surge in energy prices in 2021 followed by the early-2022 war shock contributed to inflationary pressures (Figure 2.11). Furthermore, positive second-round effects were evident in the second half of 2022, as the relative price of core became elevated compared to the levels from previous years.

Figure 2.9: Contribution to inflation



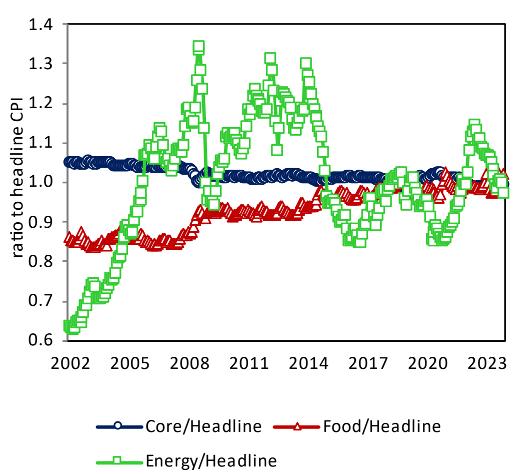
Data source: PSA

Figure 2.10: Core, goods, and services inflation



Data source: PSA

Figure 2.11: Relative prices

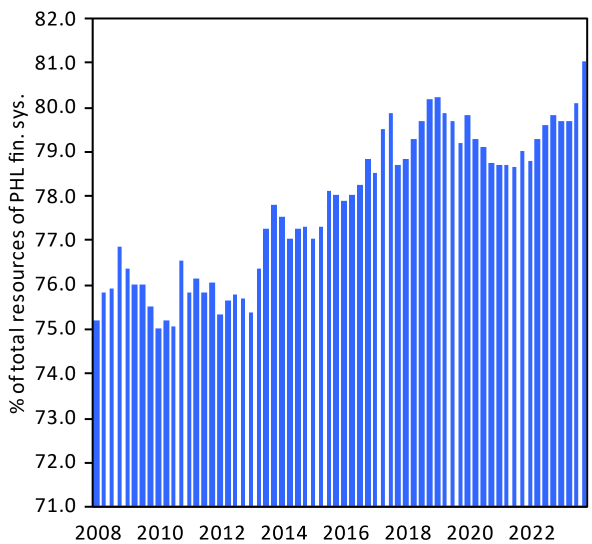


Data source: PSA

2.4 Banking Sector and Credit Cycle

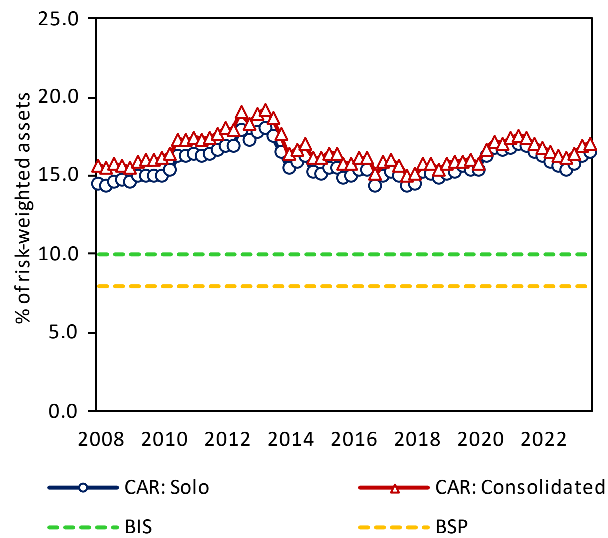
The Philippine banking sector remains the primary driver of the financial system, with banks accounting for approximately 78 percent of total financial assets from 2010 to 2023, (Figure 2.12). In 2023, Philippine banks sustained strong performance, supported by robust capital and liquidity buffers alongside continuous growth in assets, loans, deposits, and profits. They have maintained capital and liquidity buffers exceeding both the BSP and international standards. As of end-June 2023, solo and consolidated capital adequacy ratios (CARs) for Universal and Commercials Banks (U/KBs) stood at 16.3 percent and 16.9 percent, respectively, significantly surpassing the BSP's minimum requirement of 10 percent and the Bank for International Settlements (BIS) standard of 8.0 percent (Figure 2.13).

Figure 2.12: Total assets of the PHL banking system



Data source: BSP

Figure 2.13: Capital adequacy ratio



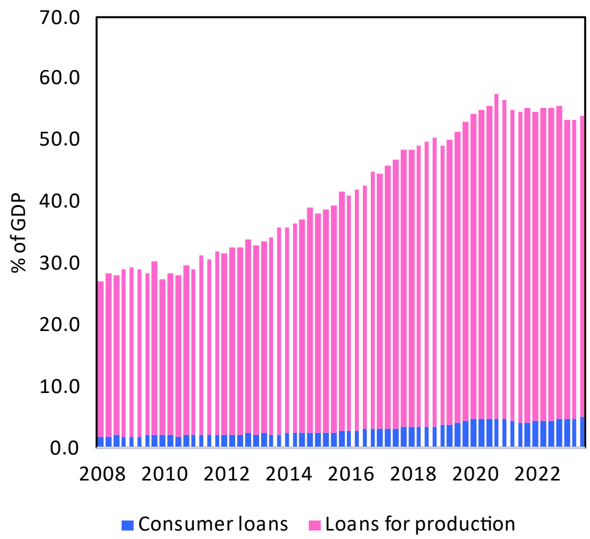
Data source: BSP

Despite the pandemic's challenges and BSP policy rate increases to curb inflation, Philippine banks adeptly facilitated funds by seamlessly offering financial products and services to households and businesses. Outstanding credit relative to nominal GDP, has risen steadily since 2010 onwards, averaging 44 percent from 2010 to 2023, underscoring the Philippines' growing economic demands (Figure 2.14). By 2023, the credit-to-GDP ratio surged to 54 percent, reflecting robust economic recovery post-pandemic, with production loans comprising over 90 percent of total credit (Figure 2.15) and increasing financial intermediation reflected in the increasing trend of credit on GDP. Concurrently, real estate credit share climbed from 13 percent in 2010 to 20 percent in 2023, mirroring sustained growth in construction and the real estate sector. A positive credit gap (Figure 2.16) has started to open in 2018 owing to rising credit growth in support of the expansion needs of the economy. Nonetheless, tighter financial conditions[9] (Figure 2.17), given the BSP's significant monetary policy tightening, exchange rate pressures, and rising property prices have helped reduce the credit gap. The credit gap in the end of 2023 has turned slightly negative.

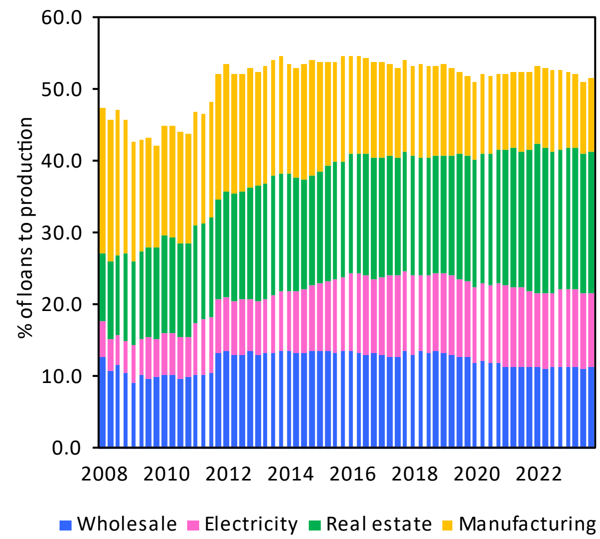
Figure 2.14: Outstanding loans (% of GDP)

Figure 2.15: Production loans by main sector

[9] The financial cycle indicator is constructed using model variables: the credit gap, the interest rate spread between lending and policy rates, and property price growth. Each variable carries equal weight in the indicator.

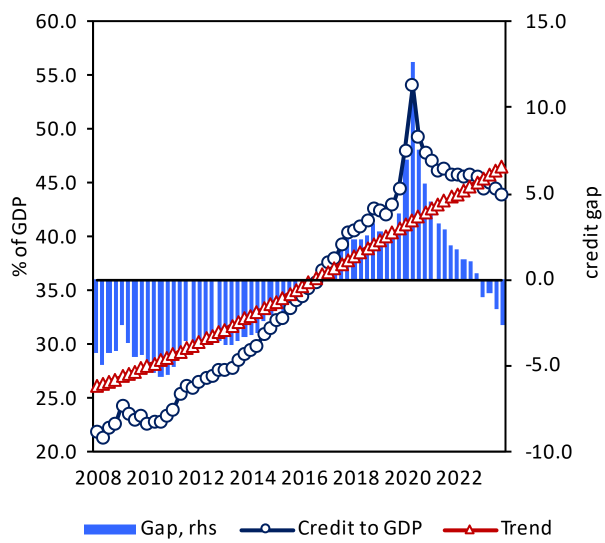


Data source: BSP



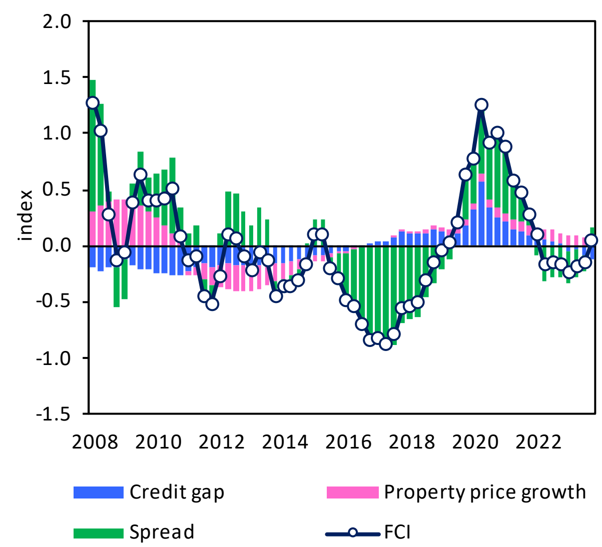
Data source: BSP

Figure 2.16: Credit gap



Data source: Staff computations

Figure 2.17: Financial conditions index

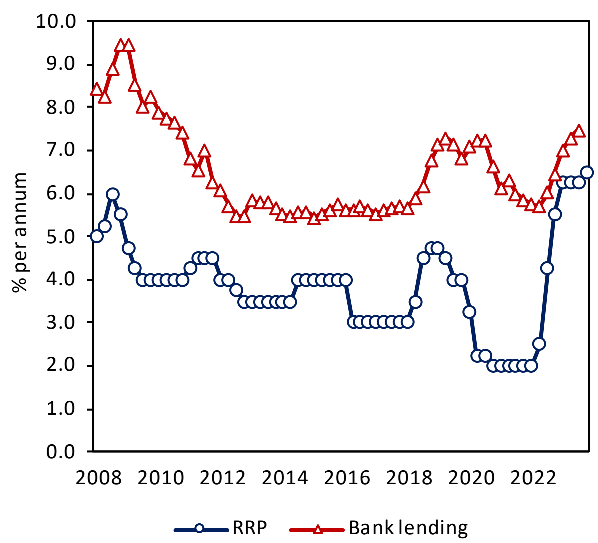


Data source: Staff computations

The average bank lending rate[10] (Figure 2.18) has generally tracked the BSP policy rate. The positive spread reflects both term premium, a product of maturity transformation, and credit risk. The positive spread between the two rates widened considerably during the pandemic when economic sentiments were negative and risk perception was heightened. Results of the BSP Senior Bank Loan Officers' Survey showed net tightening of overall credit standards for both loans to enterprises and households during the COVID-19 pandemic.

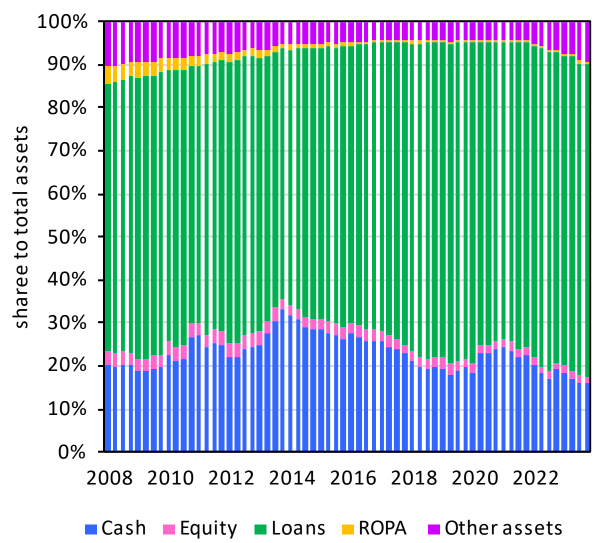
Reflecting the banking sector's pivotal role in financial intermediation and the economy's dependence on it due to the nascent domestic capital markets, loans have consistently dominated banks' balance sheets (Figure 2.19). Increasing from 63 percent in 2010 to around 73 percent in 2023, loans remained as significant portion of U/KB's total assets. Meanwhile, the capital-to-asset ratio (leverage ratio) has maintained stability at approximately 12 percent, apart from a temporary surge in Q1 2013 attributed to a notable uptick in bank capital (Figure 2.20).

Figure 2.18: Interest rates



Data source: BSP

Figure 2.19: Composition of assets of U/KBs

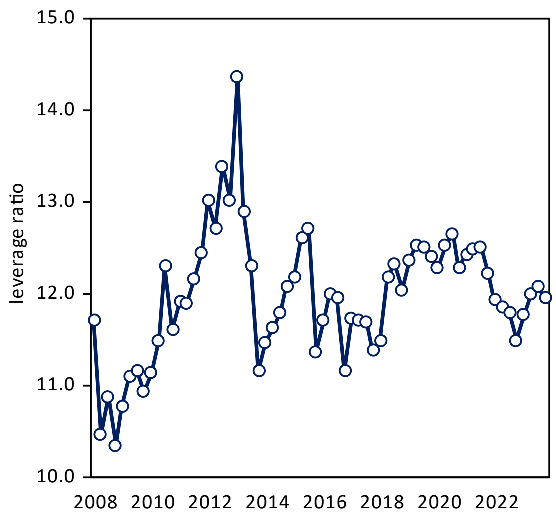


Data source: BSP

The capital of Philippine banks has, in turn, been supported by profitable operations and high-quality assets. After dipping slightly during the pandemic reflecting the contraction in economic activity, return on assets (ROA) has improved with the calibrated reopening of the domestic economy and phased removal of regulatory relief measures that allowed banks to resume normal banking operations. As of Q4 2023, ROA of U/KBs (Figure 2.21) has risen to 1.5 percent from 0.8 percent at the height (Q1 2021) of the pandemic, while the share of non-performing loans to total assets fell to 1.6 percent from 2.1 percent during the same period.

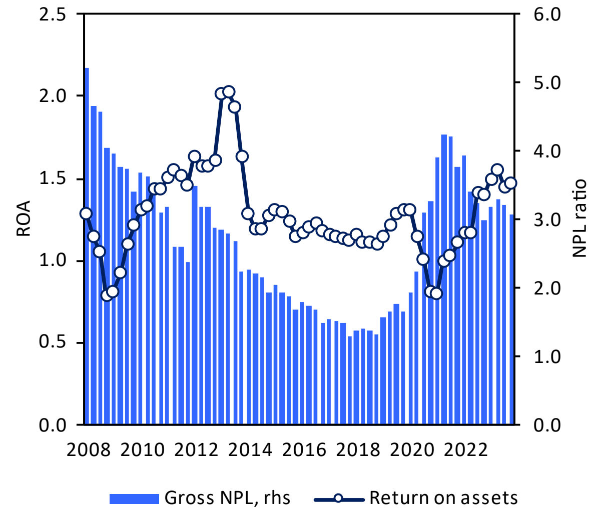
[10] The average bank lending rate refers to the average of U/KBs' reported quoted or indicative high/low lending rates as reported in the Interest Rates on Loans and Deposits (IRLD) survey. Prior to 2020, the said rate is based on reporting U/KBs' interest income and outstanding peso-denominated loans.

Figure 2.20: Leverage ratio



Data Source: BSP

Figure 2.21: ROA and NPL ratio



Data source: BSP

BSP macroprudential measures are in place but remain limited. The framework that sets up the countercyclical capital buffer (CCyB) implementation for U/KBs and subsidiary banks was announced in December 2018 (BSP Circular No. 1024). Nonetheless, the mechanism to operationalize the CCyB, including the decision-making framework, is not yet active. Philippine banks are currently subject to a CCyB of 0.0 percent with upward adjustment in CCyB to be determined by the Monetary Board when systemic conditions warrant. Any increase in the CCyB rate will be effective 12 months after its announcement but decreases will be implemented immediately. In addition, the BSP has pre-deployed macroprudential measures that can be adjusted in a countercyclical manner to prevent financial imbalances. Examples of these include caps on loan-to-value ratios, general loan loss provisioning, single borrower limits, concentration limits, limits on open FX positions, asset cover for banks' foreign currency deposit unit (FCDU) liabilities, and liquidity measures.

2.5 Monetary Policy and Transmission Mechanism

The BSP has adopted a flexible inflation targeting (FIT) framework in conducting monetary policy. Its primary instrument is the overnight reverse repurchase (RRP) rate, which the BSP adjusts based on the emerging outlook for inflation, GDP growth, and other macroeconomic variables (e.g., interest rates, exchange rate, domestic credit and equity prices, indicators of demand and supply, and external economic conditions).

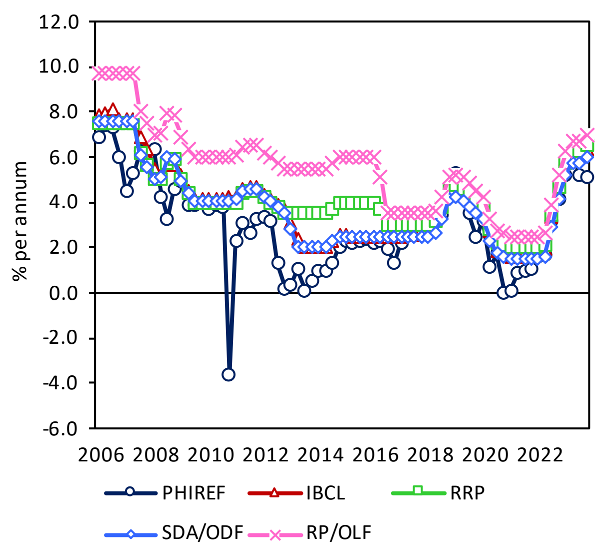
The BSP has been operating a symmetric interest rate corridor (IRC) since June 2016, with the deposit and lending facility rates set 50 basis points (bps) below and above the target RRP rate. As the BSP adjusts the target RRP rate based on its outlook for inflation and business cycle, the interest rates for the overnight deposit and lending facilities are correspondingly set. The BSP also operates active term liquidity facilities to help absorb structural excess liquidity from the financial system in aid of monetary transmission. These include the auctions for 7- and 14-day term deposit facilities, and the 28- and 56-day BSP Securities. The BSP can likewise adjust the reserve requirements, which currently stands at 9.5 percent for U/KBs from its double-digit level in the past decade, and the rediscount rate on loans extended by the BSP to banking institutions. The BSP can also undertake outright sales or purchases of government securities to adjust the liquidity in the financial system.

The passthrough of policy rate adjustments to overnight market rates is generally high. Both the IBCL and overnight PHIREF rates broadly track the movements of the RRP rate. Post adoption of the IRC system in 2016, a correlation coefficient of 0.99 between the RRP and IBCL rates was observed. The correlation for PHIREF was slightly lower at 0.92. On average, both rates fall below the RRP rate but the IBCL rate has a smaller spread against the RRP rate. Traditionally, the BSP has utilized the unsecured IBCL rate, along with other market interest rates, as its primary indicator to guide open market operations. However, following the implementation of variable-rate RRP auctions in September 2023, the BSP looks at the overnight RRP rate as its principal market rate.

The real interest rate remained negative for much of 2020-2022 due to policy rate cuts amid the COVID-19 pandemic. However, it has since trended higher reaching 3.7 percent in Q1 2024, following the 450-bp increase in the RRP rate by the BSP to address significant inflation pressure.

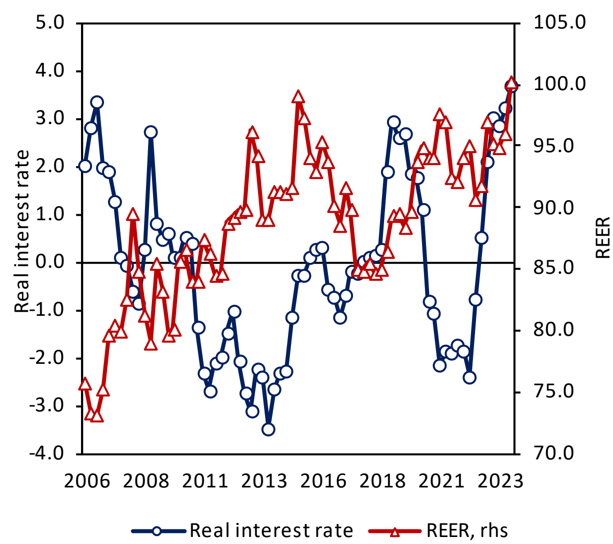
While the passthrough of policy rate adjustments to short-term market rates appear to be high, the passthrough for interest rates at the longer horizon could be moderated. For instance, the interest rate for long-term bank loans may be influenced by perception of risks on economic prospects and inflation as well as credit worthiness of borrower.[11]

Figure 2.22: O/N PHIREF, IBCL, RRP, ODF, and OLF rates



Data source: BSP

Figure 2.23: Real interest rate and real effective exchange rate



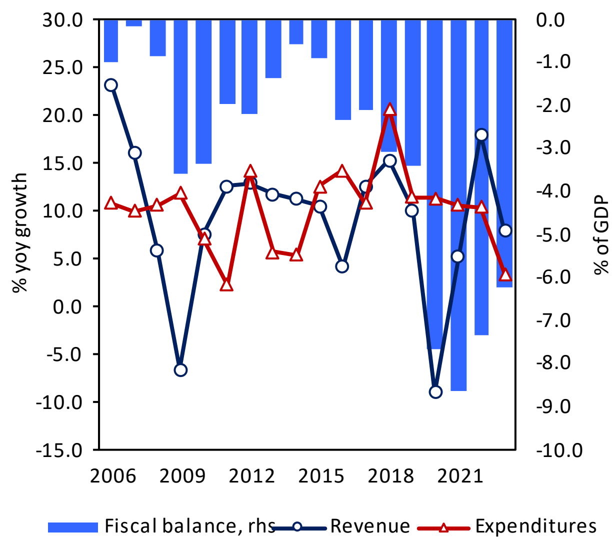
Data source: BSP

[11] The funding costs of banks are also affected by reserve requirements and other government regulations. Furthermore, the yields on long-term government securities are also influenced by the level of indebtedness and country risk premium.

2.6 Fiscal Policy and Public Finances

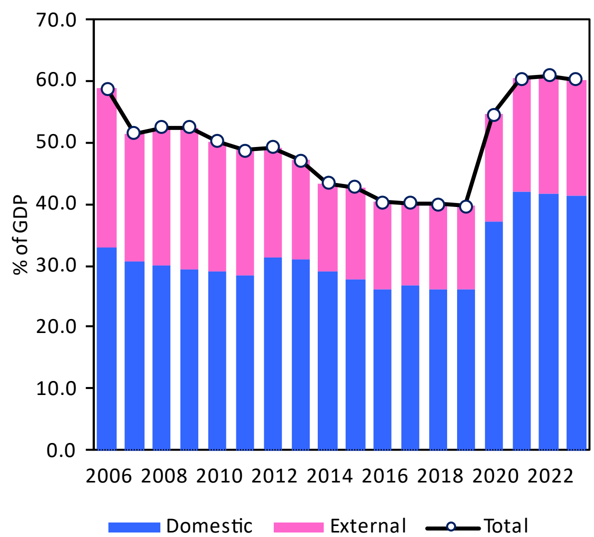
Since the onset of the COVID-19 pandemic in 2020, the fiscal balance has widened as the government pursued fiscal accommodation to support the economy amidst the global health crisis. Transitioning from an average of 2.9 percent from 2017 to 2019, the fiscal deficit to GDP ratio more than doubled to 7.9 percent from 2020 to 2022 (Figure 2.24). In 2020, total government revenues contracted by 9.0 percent due to reduced business operations amid necessary mobility restrictions aimed at curbing the spread of the virus. However, revenues rebounded by 18.0 percent in 2022, propelled by higher tax collection, as pent-up demand drove increased economic activity. To address the pandemic and its containment measures, the government enacted *Bayanihan* 1[12] and *Bayanihan* 2[13] in 2020 to implement emergency health and social protection programs.[14] Additionally, the notable increase in government spending in 2018 was fueled by growth in infrastructure and other capital expenditures.

Figure 2.24: NG fiscal performance



Data source: BTr

Figure 2.25: NG outstanding debt (% of GDP)



Data source: BTr

The country's larger financing requirements coupled with weaker domestic output growth, led to increased debt levels. Prior to the pandemic, the government debt-to-GDP ratio remained stable at about 40 percent, reflecting prudent debt management and robust economic growth (Figure 2.25). However, total outstanding debt rose in 2020, reaching 61 percent of GDP by the end of 2022, with the national government (NG) favoring domestic borrowing to manage foreign exchange risks.

In pursuit of short-term macro-fiscal stability and medium-term fiscal sustainability, the government adopted the 2022-2028 Medium-Term Fiscal Framework (MTFF) in 2022. Through this framework, originally the government announced its medium-term goals, aiming to reduce the fiscal deficit to 3.0 percent of GDP by

[12] *Bayanihan* to Heal as One Act or Republic Act (R.A.) No. 11469 was enacted on 24 March 2020.

[13] *Bayanihan* to Recover as One Act or R.A. No. 11494 was enacted on 11 September 2020.

[14] Such programs include the Social Amelioration Program, the COVID-19 Adjustment Measure Program, and the Small Business Wage Subsidy Program. The funds were sourced from pooled savings through the discontinuation of government projects that were appropriated during the budget formulation. Source: Annual Fiscal Report 2020.

2028 and the NG debt to less than 60 percent of GDP by 2025.[15] To achieve these targets, the government plans to increase revenues through existing tax measures such as the Sin Tax Law and the Tax Reform for Acceleration and Inclusion (TRAIN), along with proposed priority tax measures, and enhanced tax administration efficiency through digitalization. In addition to the priority tax measures outlined in the MTFF, such as imposing value-added tax on digital service providers and excise tax on single-use plastics, the government is also seeking to improve the fiscal regime for the mining industry and implement a motor vehicle road user's tax, among other initiatives. On the expenditure side, the government aims to modernize the budgeting system through the Progressive Budgeting for Better and Modernized Government Bill, streamline NG agencies with the National Government Rightsizing Program, and mitigate fiscal risks related to military and uniformed personnel pensions.

2.7 External Balance

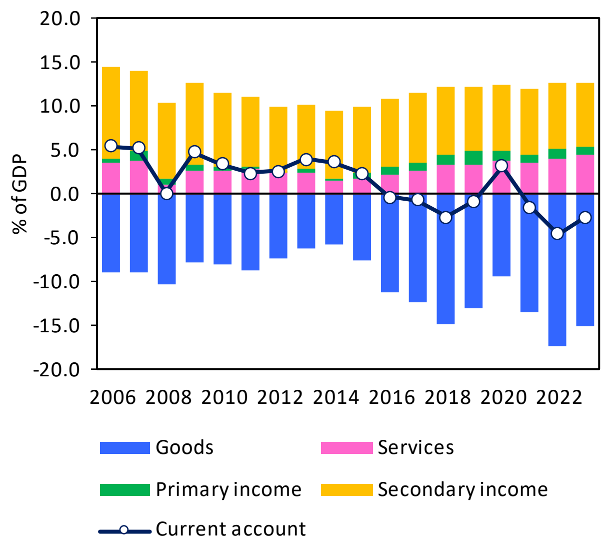
The Philippines experienced large fluctuations in its current account balance over the past decade. Initially in surplus and averaging 3.0 percent of GDP from 2011 to 2015, the current account shifted to a deficit from 2016 to 2019, averaging -1.1 percent of GDP, before returning to a large surplus in 2020 at 3.2 percent of GDP (Figure 2.26). These fluctuations were driven mainly by widening and narrowing trade deficits in goods while balances in other accounts such as services, primary, and secondary income remained stable. Furthermore, substantial current account deficits emerged in 2021-2022, subsequently narrowing in 2023. This trend was driven by the reduction in the deficit for goods, offset by the uptick in service imports fueled by pent-up demand for travel. Both primary and secondary income accounts have made favorable contributions to the current account balance.

The Philippines consistently maintained robust foreign reserves to finance this deficit. From 2004 to 2011, reserves increased from 106 percent to a peak of 273 percent of the IMF's ARA metric. By the end of 2023, gross international reserves (GIR) had reached US$102.5 billion, up from US$44.2 billion in 2009 (Figure 2.27) following the GFC. This increase was driven by increased dollar inflows due to the US Fed's quantitative easing and ultra-low interest rate policy. Similarly, GIR surged in 2020 due to increased foreign loans by the NG in response to the COVID-19 pandemic and funding for the country's infrastructure program. The steady flow of dollar remittances from overseas Filipino workers (OFW) and receipts from business process outsourcing (BPO) firms have also contributed to the growth of foreign reserves.

Total capital flows grew more moderately, averaging 3.6 percent of GDP in the 2000s to 5.4 percent of GDP in the 2010s. This increase was partly due to the low interest rate regime in advanced economies post-GFC, leading to a search for yield in EME bond markets (Figure 2.28). Additionally, the BSP's foreign exchange liberalization reforms since 2007 and changes in foreign bank entry regulations in 2014 also contributed to the rise in capital flows. Despite these reforms, the Philippines still maintains substantial capital flow restrictions, as indicated by the Fernandez, et al. (2016) index, which classifies the Philippines as a "wall" country, with controls in over 70 percent of cross-border transactions (Figure 2.29) (IMF 2022). Similarly, the Chinn-Ito index (Chinn, et al. (2006)) indicates a low degree of capital account openness for the Philippines, reflecting significant barriers to capital movements across borders.

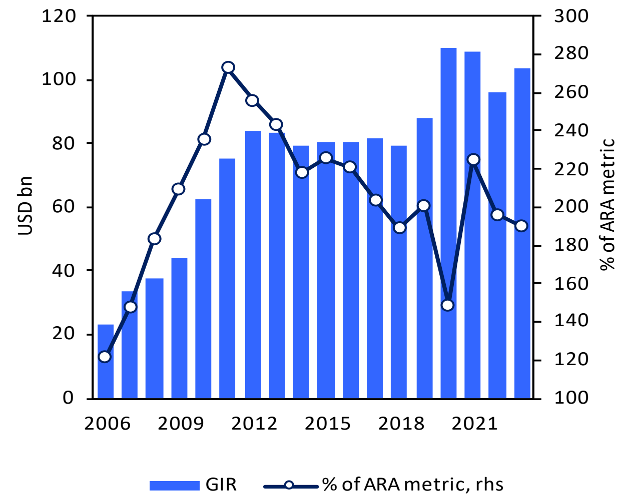
[15] In 2024, the government reviewed the program and revised the deficit target to 3.7 percent for 2028, along with adjusting the debt-to-GDP target to 55.9 percent for the same year.

Figure 2.26: Current account balance (% of GDP)



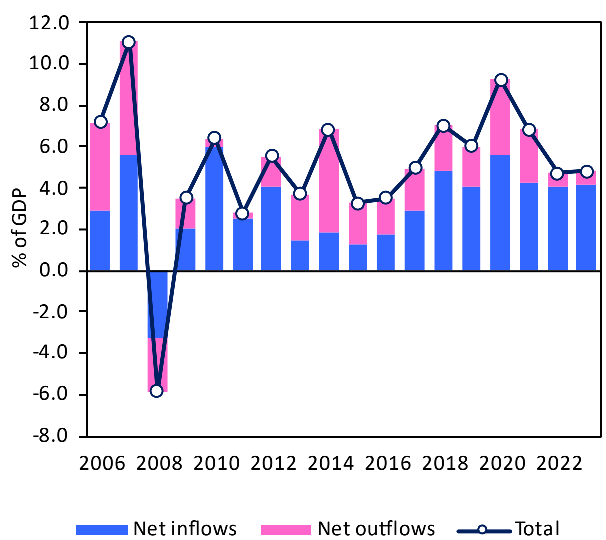
Data source: BSP

Figure 2.27: Gross international reserves (USD bn)



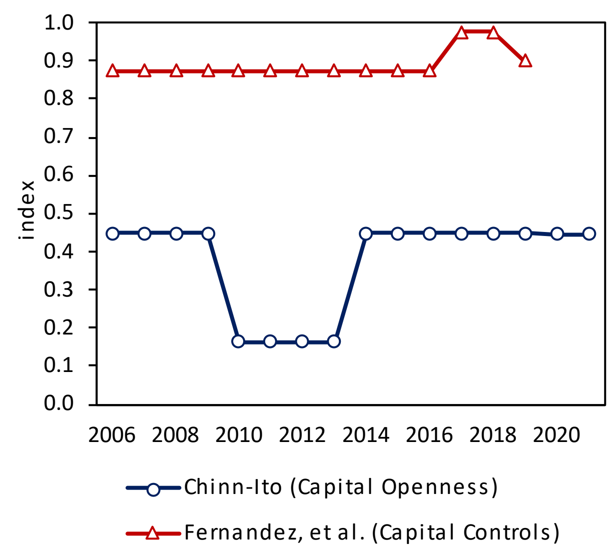
Data source: BSP, IMF

Figure 2.28: Total capital flows (% of GDP)



Data source: BSP

Figure 2.29: Financial openness

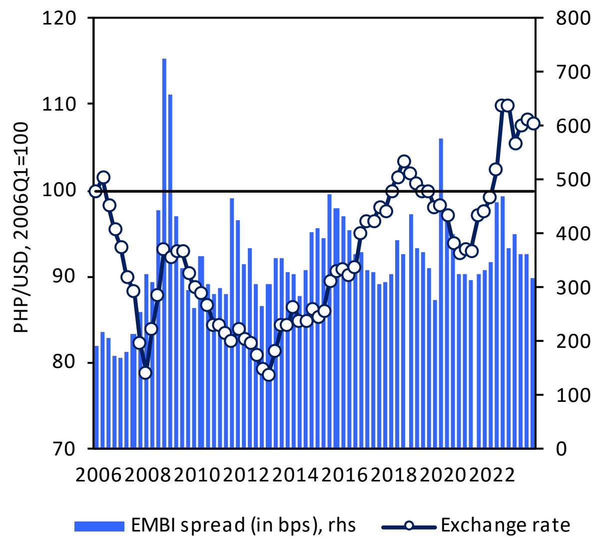


Data source: Fernandez, et al. (2016) and Chinn, et al. (2006)

The Philippine Emerging Markets Bond Index (EMBI) spread, a key metric of country risk premium, currently sits around 300 bps (Figure 2.30). This reflects significant improvement compared to peaks of 724 bps and 577 bps during the GFC and the COVID-19 pandemic, respectively. The relative stability in the EMBI spread in recent years indicated the Philippines' enhanced resilience against external economic shocks. This resilience can be attributed to sustained economic growth and sound macroeconomic fundamentals, bolstered further by successive credit rating upgrades in the early-2010s.

Meanwhile, the peso-dollar rate depreciated from 2013 to 2018, coinciding with the US Federal Reserve tapering its asset purchases, which triggered liquidity concerns globally and heightened risk perception. Consequently, emerging market currencies, including the Philippine peso, weakened as investors sought safer destinations for their funds. From 2019 through 2021, the peso appreciated against the dollar on the back of low and stable inflation, strong and resilient banking system, and high level of international reserves. The current account surplus during the pandemic likewise supported the strength of the peso. As the global economy reopened and faced the headwinds of higher commodity prices due to geopolitical tensions in 2022, several advanced economies have begun aggressive monetary policy tightening. This has resulted in renewed depreciation of the peso to its current level.

Figure 2.30: EMBI spread and exchange rate



Data source: Bloomberg, BSP

2.8 Foreign Trade

The Philippines has experienced a trade deficit for most years, as imports of capital goods, consumer goods, and raw materials surpassed the value of key exports such as electronic products, machinery, textiles, and agricultural products. The country's major trading partners included the United States, China, Japan, South Korea, and ASEAN member countries. Key exports included electronics, semiconductors, clothing, machinery and equipment, coconut oil, and tropical fruits. Imports consisted primarily of intermediate goods and capital equipment essential for domestic production and infrastructure development, crucial for sustaining economic growth. Additionally, the external sector benefited from remittances from the OFWs and receipts from tourism and BPO industry.

External Assumptions. The external block of the PAMPh is determined by forecasts from the Global Projections Model Network (GPMN), which uses the GPM++ Model. This model, originating from the IMF's Global Projection Model, covers approximately 30 countries, representing around 80 percent of the world GDP. It encompasses commodities and financial linkages to the real economy.[16] Global macroeconomic variables

[16] Source: GPMN website

adopted exogenously by the PAMPh include output gap and CPI changes in key regions, namely the US, Euro Zone, China, Japan, and others. Price changes of oil and food in the international market that impact domestic food and energy inflation directly, are sourced from GPM++ projections. Estimated spillovers and exchange rate changes from these regions, along with the impact of interest rate movements from major central banks like the US Federal Reserve, are also incorporated into PAMPh.

3. A Modern Policy Analysis Model for the Philippines (PAMPh2.0)

The economic considerations and transmission mechanisms detailed earlier are integrated into the PAMPh structure, making it a relevant and effective tool for real-time policy analysis and forecasting. Inspired by FINEX, PAMPh2.0 emphasizes external and internal balances by explicitly incorporating macroeconomic and financial blocks, reaction functions and rules. This integration establishes a comprehensive policy framework with diverse instruments, significantly enhancing the depth of policy analysis. Specifically, the framework provides a systematic and practical method for structured forecasting and policy analysis, integrating traditional monetary and fiscal policies with non-traditional tools such as FXI, CFMs, and MPMs, and assessing their interaction in response to economic shocks. Moreover, PAMPh2.0-based analysis of fiscal-monetary-macrofinancial interactions takes into account crucial factors like initial debt levels and the sensitivity of inflation to exchange rate depreciation, among others.

PAMPh2.0 incorporates insights from recent DSGE literature while maintaining a gap-trend structure conducive to practical policy applications, emphasizing a “positive” policy analysis approach. This framework is designed to facilitate the interpretation of recent data in terms of structural shocks and policy responses, aiding policymakers in constructing internally-consistent medium-term baseline projections, economic narratives, and conducting alternative scenarios. Appendix [D] offers an overview of the practical utilization of structural and semi-structural models within policy institutions, emphasizing the roles of PAMPh2.0 and other DSGE-based policy models such as the quantitative model for the Integrated Policy Framework (QIPF). [17]

Macroeconomic dynamics in PAMPh2.0 depend on the interplay of internal balance, external balance, and policy. *Internal balance* is woven into the determination of both output and inflation. This relationship is elucidated through the interaction of demand and supply, represented by an extended IS curve and a corresponding set of Phillips curves. Moving to *external balance*, the exchange rate plays a pivotal role in reconciling the balance of payments (BoP), thereby exerting influence on net exports and other components within the BoP framework. The dynamics of financial flows are contingent upon the difference between domestic and foreign interest rates, adjusted for anticipated depreciation, thereby deviating from the Uncovered Interest Parity (UIP). This straightforward formulation encapsulates the implications of external shocks and policies, including FXI, which significantly impacts the necessity for portfolio capital flows to maintain equilibrium within the BoP. CFMs further play a distinctive role, influencing the effective interest rate for foreign investors, shaping the stock of Net Foreign Assets (NFA), and thereby shaping the economy’s response to external shocks. As for *policy*, the levers of monetary policy, fiscal policy (encompassing government

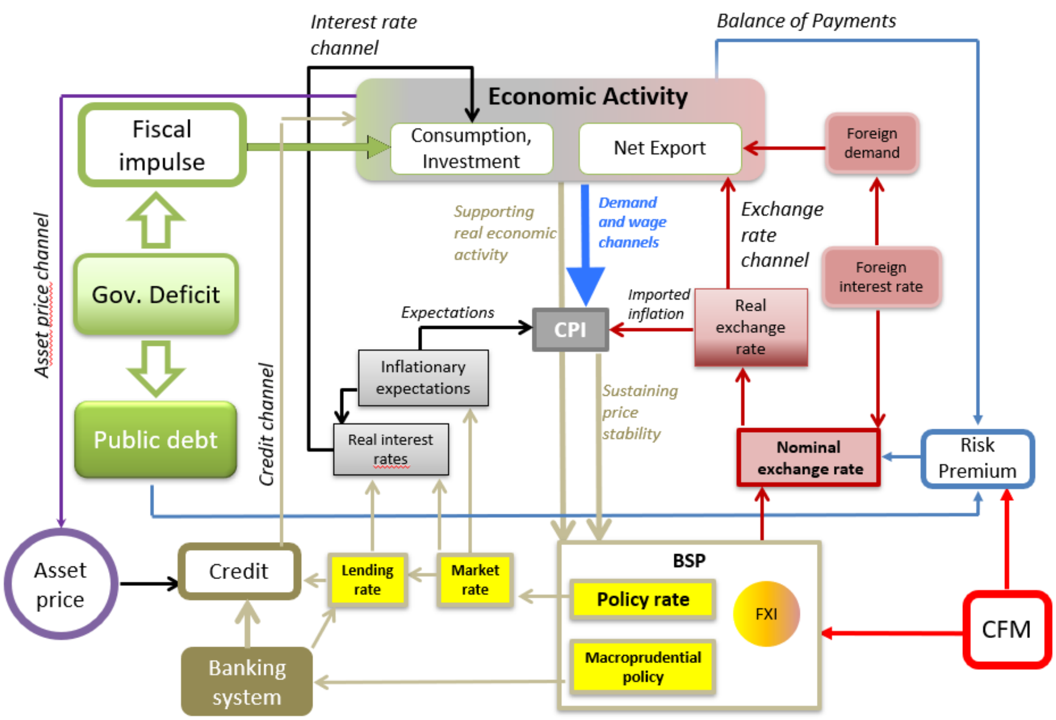
[17] This paper does not draw broad policy lessons or identify shortcomings in forecasting or policy analysis models, unlike Basu and Gopinath (2024), who review Mundell-Fleming and suggest changes for comprehensive policies under financial frictions, which we integrate into our practical policymaking model.

absorption through consumption and investment, along with tax considerations), FXI, MPMs, and CFMs[18] are inherently linked to variables such as inflation, output, debt, exchange rate, and other specified objectives. Additionally, there is an increased emphasis on labor market policies to provide deeper insights into the analysis of labor market dynamics and their implications for inflation forecasts.[19]

It is essential to acknowledge from the outset that within the framework of PAMPh2.0, as demonstrated in the subsequent risk scenario analyses and policy simulations, the policy reaction parameters are not optimized but rather calibrated (discussed further in Section 4.2). While it is conceivable to optimize the reaction functions based on a loss function, the resulting outcomes would inherently depend on several factors, including the calibration of the economy, the distribution of shocks, and the characteristics of the policy regime. For instance, the extent of the interest rate reaction to inflation would be influenced by the strength of the FXI response to changes in the exchange rate. Policymakers are aware that models only approximate reality in many cases, thus they often prioritize flexibility in reflecting their own preferred reaction functions. Nevertheless, they still rely on the resulting model forecasts as a crucial tool to assess the policy stance.

The main structural assumptions and channels in PAMPh2.0 are depicted in Figure 3.1.

Figure 3.1: PAMPh2.0 – Diagram of Key Relations and Channels



18 A central bank wields a policy interest rate, possibly complemented with FXI and CFMs. The government sets various fiscal instruments.

19 Based on Karam, Musil, and Vlcek, 2024 "An Extended QPM with Labor and Wages." (Forthcoming IMF WP).

In Figure 3.1, we underscore certain aspects of *internal and external balances*. The output gap serves as a metric for the cyclical positioning of GDP, shedding light on distinct contributions from consumption, investment, and net exports. Household private consumption and investment activities are influenced by monetary conditions (real interest rate and lending conditions) and are impacted by the income channel. Export levels hinge on foreign demand and competitiveness (assessed through the real exchange rate and real export prices) while imports are propelled by domestic demand and an expenditure-switching mechanism. Real exchange rate depreciation prompts a reduction in the demand for foreign goods, thereby enhancing the net export position. Inflationary pressures emanate from the output gap, imported inflation, and the effects of commodity prices.

Shifting the focus to *policies*, they play a fundamentally stabilizing role, with monetary policy adhering to the Taylor principle and fiscal policy aimed at stabilizing the debt-GDP ratio.[20]

Regarding monetary policy, the BSP employs three tools to fulfill its mandate of maintaining price stability and supporting real economic activity:

1. Operating within an adopted (FIT) regime, the BSP determines the policy rate based on a Taylor rule. Monetary policy typically responds to anticipated inflation deviations from the targeted (midpoint) 3 percent level and the cyclical position of GDP, effectively fulfilling its stabilizing function. This approach also influences short-term nominal exchange rates and (imported) inflationary pressures.
2. Given the relatively low scale of FX turnovers, the shallowness of the Philippines' FX market (see IMF Country Report No. 23/415 (Philippines Selected Issues); necessitates FX intervention in cases of disorderly market conditions (DMC). In such instances, monetary policymakers may intervene in the FX market to stabilize the peso, alleviating sharp depreciation pressure from capital outflows. This intervention may also help prevent de-anchoring inflation expectations, thereby safeguarding macroeconomic soundness and price stability.
3. Functioning as a financial regulator, the central bank can adjust reserve requirements or implement other macroprudential policies to influence private sector access to credit activity. This provides an additional lever to steer macroeconomic and financial stability.

Regarding fiscal policy, PAMPh2.0 features a simple, parsimonious model using a reaction function in which fiscal authorities aim to maintain public debt at a targeted level and stabilize economic activity by keeping economic growth close to its potential level. The reaction function guides fiscal policy decisions: the government decides on the level of the cyclically-adjusted primary balance based on factors such as the deviation of public debt from the targeted level and the cyclical position of the economy. Government instruments—multiple sources of revenues and current and capital spending (including social transfers) are adjusted to achieve the fiscal balance target. Tax-based vs. expenditure-based fiscal consolidation is highlighted in the policy section below with a greater need for coordination between monetary and fiscal policy. Further, the government's reaction to economic conditions through fiscal policy decisions feeds back into real economic activity. The fiscal impulse (the change in fiscal policy stance) has an impact on economic activity and fiscal policy decisions also influence inflation (through a second-round inflationary effect, which is limited).

[20] In the so-called PAMPh2.0 gap model, an important characteristic is that the economy evolves around an underlying, but well-defined, equilibrium path. The gaps develop when the economy deviates from such path, in general caused by a variety of shocks. The role of monetary policy is to assist in closing the gaps by guiding the economy back to its equilibrium path, importantly, inflation back to its target.

The detailed exposition of the BoP and external financing in PAMPh2.0 incorporates crucial and innovative elements derived from Berg et al. (2023). The net export position serves as the linchpin for the underlying dynamics of the current account, influenced further by additional foreign-related income, interest income and foreign direct investment return. The financial account, mirroring the current account, dictates the external financing position of the economy. The country risk premium, contingent on external financing, shapes the dynamics of the nominal exchange rate, thereby influencing inflation pressures. PAMPh2.0 is also equipped to examine scenarios where policymakers implement CFMs to restrict the private sector's access to foreign financing, subsequently addressing the adverse effects of capital outflows or DMCs.

Finally, Figure 3.1 depicts a banking sector with credit channels, inspired by QPM-style models. This addition enriches the model and facilitates specific credit and asset price channels and interactions. Within this framework, commercial banks extend consumer credit to households and collateralized credit to firms for housing. The lending rates are tied to compounded effective market rates (which will be discussed below), closely connected to the monetary policy rate. Additionally, asset prices, intimately associated with real economic activity, dynamically influence the collateral credit position, introducing endogenous financial cycles within the model.

Most of the model equations are *linear*. However, *nonlinearity* has also been incorporated. This is the case in the macroprudential block, for example, when U/KBs first reduce dividend payments built-up capital. Only when it is not sufficient, banks raise spreads. Similar nonlinear effects are used in the case of public debt or limits on FXI when reserves get too low.

Before we dive into the model structure and relationships, let's introduce some notation. All variables are expressed in log variables and decomposed into gap and trend components. The gaps, percentage deviation from the potential or trend level, are described by detailed structural equations associated with the macroeconomic theory. We denoted the gaps by hat over the variable ($\widehat{\ }$), e.g., the output gap is written as $\hat{y}$. The trends are described with relatively simple autoregressive processes and are assigned by bar ($\bar{\ }$), e.g., the potential GDP is denoted by $\bar{y}$. The structural equations for the fiscal and external balance contain variables in terms of nominal GDP (or we also refer to the variables expressed in terms of nominal GDP as great ratios); for these variables, we add a superscript $(\ )^{rat}$, e.g., $debt^{rat}$ denotes the public debt to GDP ratio.

We will now elaborate on each internal and external balance and policy sequentially.

3.1 Internal Balance

3.1.1 Real Economy and Aggregate Demand

PAMPh2.0 follows in large part the advances made by Berg et al. (2023) in terms of QPM development. GDP (Y) on the expenditure side is decomposed into private consumption (C), gross capital accumulation (Inv), government consumption (Gc), export (X) and import (M). Corresponding price deflators for each GDP component are modeled, denoted by P with the superscripts referring to the different GDP components.

$$P_t^Y Y_t = P_t^C C_t + P_t^{Inv} Inv_t + P_t^{Gc} Gc_t + P_t^X X_t - P_t^M M_t \tag{1}$$

Most of the model equations including the GDP-identity are expressed in a linearized version. The GDP (output) gap ($\hat{y}$) is computed as the weighted average of the expenditure-side components, with the time-variant weights derived from the nominal GDP ratios in relation to potential levels:

$$\hat{y}_t = \frac{\bar{c}_t^{rat}}{100}\hat{c}_t + \frac{\overline{inv}_t^{rat}}{100}\widehat{inv}_t + \frac{\overline{gc}_t^{rat}}{100}\widehat{gc}_t + \frac{\bar{x}_t^{rat}}{100}\hat{x}_t - \frac{\bar{m}_t^{rat}}{100}\widehat{m}_t + \varepsilon_t^{\hat{y}} \quad (2)$$

Eq.1 is also applicable to trend variables. The GDP trend can be represented as the weighted average of the growth rates of each expenditure-side component, with weights determined by the nominal GDP ratios, as follows:

$$\Delta\bar{y}_t = \frac{\bar{c}_{t-1}^{rat}}{100}\Delta\bar{c}_t + \frac{\overline{inv}_{t-1}^{rat}}{100}\Delta\overline{inv}_t + \frac{\overline{gc}_{t-1}^{rat}}{100}\Delta\overline{gc}_t + \frac{\bar{x}_{t-1}^{rat}}{100}\Delta\bar{x}_t - \frac{\bar{m}_{t-1}^{rat}}{100}\Delta\bar{m}_t + \varepsilon_t^{\bar{y}} \quad (3)$$

Cyclical position of GDP expenditure side components

First, we outline the gap equations, illustrating the key characteristics of New Keynesian theory. Each equation can be associated with a reduced linearized equation in DSGE models.

The consumption gap adheres to the fundamental properties of the Euler equation observed in applied DSGE models with external habit formation (Smets and Wouters, (2007)). It is a function of both backward and forward-looking expectations, monetary conditions, and the disposable income position:

$$\begin{aligned}\hat{c}_t &= a_1\,\hat{c}_{t-1} + a_2 E_t\,\hat{c}_{t+1} - a_3(a_4\hat{r}_t^L + (1-a_4)\hat{r}_t + a_5\widehat{prem}_t)\\ &+a_6\left(\hat{y}_t + a_7\left(\frac{\bar{x}_t^{rat}}{100}\widehat{rp}_t^X - \frac{\bar{m}_t^{rat}}{100}\widehat{rp}_t^M\right)\right) + a_8\widehat{remit}_t^{rat} - a_9\widehat{rev}_t\\ &+a_{10}(\widehat{wr}_t + \widehat{rp}_t^{core} - \widehat{rp}_t^C) + a_{11}\varepsilon_t^{\widehat{ncr}^{h,rat}} + \varepsilon_t^{\hat{c}}\end{aligned} \quad (4)$$

where consumption gap, denoted by ($\hat{c}$), is influenced by various factors. The real interest rate gap ($\hat{r}$), encompassing the real loan rate gap ($\hat{r}^L$), and the risk premium gap ($\widehat{prem}$), constitutes the monetary conditions. Tight monetary conditions, resulting from restrictive monetary policy or tight lending conditions set by commercial banks, lead to a lower consumption gap. The income component comprises the output gap ($\hat{y}$), terms-of-trade from export ($\widehat{rp}^x$) and import ($\widehat{rp}^m$) relative price gaps[21], remittances ($\widehat{remit}^{rat}$), wages paid will be approximated by a real wage gap ($\widehat{wr}$, defined below) adjusted by the relative price difference between the core prices ($\widehat{rp}^{core}$) and consumption deflators ($\widehat{rp}^c$), and taxes paid as a source of revenue to the government ($\widehat{rev}$). The consumption equation contains two shocks, $\varepsilon^{\hat{c}}$ denotes the preference shocks that increase the idiosyncratic changes of the consumption gap, while $\varepsilon^{\widehat{ncr}^{h,rat}}$ is the shock to household credit implying that access to a better credit position also results in higher consumption. The income channel plays a prominent role in capturing the second-round effects of labor, capital and dividend income from firms and the effect of fiscal redistribution policies. The relative price gaps illustrate the potential impact of the foreign trading sector: the increasing profitability of Philippine exporters is reflected in the rising real price of exports, while the

[21] The relative price is calculated as the GDP deflator divided by the CPI. Following Berg et al. (2023), the relative prices can be split into gap and trend components. Relative price gaps enter equations describing the cyclical position of the economy and relative price trends are used to express the medium-term great ratios in terms of nominal GDP trend.

potential worsening terms-of-trade, with adverse effects on consumption, is captured through the real import price gap.[22] Through the expectation channel, past or future expected monetary and income conditions also play a role in determining the consumption gap.

Labor and wages

First, to provide additional insights into labor and wages in PAMPh2.0, two additional equations—a wage Phillips curve and an unemployment rate equation—are discussed below. The structure and calibration of these equations are motivated by a DSGE framework.

Business Wage Phillips Curve. Its derivation follows the approach outlined by Erceg et al. (2000), with the following shape:

$$\Delta w_t^B = \sigma_1 \Delta w_{t-1}^B + (1-\sigma_1)\mathrm{E}_t \Delta w_{t+1}^B + \sigma_2(\sigma_3 \hat{c}_t - \sigma_4 \widehat{wr}_t) + \sigma_5 \varepsilon_t^{\Delta w^M} + \varepsilon_t^{\Delta w^B} \tag{5}$$

Δw^B is nominal business wage q-o-q growth determined by the business cycle conditions, $\mathrm{E}_t \Delta w_{t+1}^B$ is the expected nominal wage growth in time t+1 based on information in time t, $\hat{c}$ is the consumption gap, $\widehat{wr}$ is the real wage gap, and $\varepsilon^{\Delta w^M}$ is the spillover effect of the minimum wage increase on business wages. Eq.5 assumes wage growth is driven by expected and actual past wage growth. It is affected by the consumption gap and the real wage gap capturing deviations of the real wage from the marginal rate of substitution between leisure and work—a positive consumption gap also implies high production and thus higher demand for labor, resulting in wage growth pressures; and a negative real wage gap means that labor is relatively cheaper compared to other production factors, raising demand for labor and nominal wage growth.

A set of additional equations accompanies (eq.5). First, a significant part of the labor force receives a minimum wage set by the government exogenously:

$$w_t^M = w_{t-1}^M + \varepsilon_t^{\Delta w^M} \tag{6}$$

where the w^M denotes the minimum wage. The total wage index is given as the weighted average of minimum and business wages:

$$w_t = \sigma_6 w_t^M + (1-\sigma_6) w_t^B \tag{7}$$

The identity defining the real wage (wr) is:

$$wr_t = w_t - cpi_t^{core} \tag{8}$$

[22] The export and import trend ratios are time-variant coefficients reflecting the real importance of the export and import sector of Philippines.

where w is a natural log of nominal wage and cpi is a natural log of consumer price index derived below from price Phillips curves.[23] The real wage is decomposed into a gap, denoted as $\widehat{wr}$, and a trend denoted as, $\overline{wr}$:

$$wr_t = \widehat{wr}_t + \overline{wr}_t \tag{9}$$

The trend real wage $\overline{wr}$ is assumed to follow an autoregressive process, where the faster-than-steady-state potential growth rate exerts additional growth on the real wage trend:

$$\Delta\overline{wr}_t = \sigma_7 \Delta\overline{wr}_{t-1} + (1-\sigma_7)\left(\Delta wr^{SS} + \sigma_8(\Delta\bar{y}_t - \Delta y^{SS})\right) + \varepsilon_t^{\Delta\overline{wr}} \tag{10}$$

where Δwr^{SS} denotes the steady-state real wage trend growth, $\Delta\bar{y}$ and Δy^{SS} are the trend (potential) real GDP growth and the steady-state real GDP growth, respectively, and $\varepsilon^{\Delta\overline{wr}}$ is a shock.

Unemployment rate. The Okun's law equation links the unemployment rate gap, denoted as $\widehat{une}$, with real economic activity:

$$\widehat{une}_t = \sigma_9 \widehat{une}_{t-1} + \sigma_{10}\hat{y}_{t-1} + \varepsilon_t^{\widehat{une}} \tag{11}$$

It assumes that the labor market operates according to the real business cycle with a lag, as reflected in the persistence of the unemployment gap and the inclusion of the lagged value of the output gap. The unemployment gap along with the trend in the unemployment rate – the NAIRU or non-accelerating inflation rate of unemployment, $\overline{une}$, provides the unemployment rate, une:

$$une_t = \overline{une}_t + \widehat{une}_t \tag{12}$$

The NAIRU is determined by the structural characteristics of the labor market and influenced by potential GDP growth:

$$\overline{une}_t = \sigma_{11}\overline{une}_{t-1} + (1-\sigma_{11})\left(\overline{une}^{ss} - \sigma_{12}(\Delta\bar{y}_t - \Delta y^{SS})\right) + \varepsilon_t^{\overline{une}} \tag{13}$$

The equation assumes that in the steady state, the level of the unemployment rate is determined by the structural characteristics determining $\overline{une}^{ss}$. This structural level is adjusted by deviations of potential GDP growth from its long-term level. Faster potential GDP growth reduces the NAIRU, while slower growth increases it.

Moving on to other aggregate demand components, the investment gap ($\widehat{inv}$) is guided by the Tobin-Q portfolio theory (Tobin and Brainard (1977)). The Tobin-Q ($\hat{q}$) serves as a measure of the market value of the capital stock, providing insights into the incentives for capital investment. When $\hat{q}$ surpasses the relative price of the actual investment, or the relative price of investment, firms tend to increase their investment in the economy. The investment equation is expressed as follows:

$$\widehat{inv}_t = a_{12}\widehat{inv}_{t-1} + a_{13}\mathrm{E}_t\widehat{inv}_{t+1} + a_{14}\hat{q}_t - a_{15}\widehat{rp}_t^{inv} + a_{16}\widehat{gi}_t^{rat} + a_{17}\varepsilon_t^{\widehat{ncr}^{f,rat}} + \varepsilon_t^{\widehat{inv}} \tag{14}$$

[23] The choice of deflator for computing the real wage depends on the model structure. Either the GDP deflator, consumption deflator, or CPI can be utilized.

Here Tobin-Q is defined as the present value of the next period's output level and the future value of portfolio investment:

$$\begin{aligned}\hat{q}_t &= a_{18}\left(\mathrm{E}_t\hat{y}_{t+1} + a_{19}\mathrm{E}_t\widehat{zh}_{t+1}\right)\\ &\quad -a_{20}(a_{21}\hat{r}_t + a_{22}\hat{r}_t^L + (1 - a_{21} - a_{22})\widehat{prem}_t)\\ &\quad +a_{23}\mathrm{E}_t\hat{q}_{t+1}\end{aligned} \tag{15}$$

The expected value of the output gap serves as a proxy for the yields on capital. A combination of the real interest rate gap, the real lending rate gap, and the risk premium is employed as an effective measure for monetary conditions to discount the expected market value of future investments. Additionally, in eq.15, the investment equation incorporates public capital expenditures ($\widehat{ex}^{i,rat}$) as a substantial component of gross capital accumulation in the Philippines, driven by public capital expenditures and infrastructure projects. The shock to firms' new credit ($\varepsilon^{\widehat{ncr}^{f,rat}}$) contributes to the investment positively. The shock term ($\varepsilon^{\widehat{inv}}$) accounts for the unmodelled part of investment activity, representing a temporary shock. Notably, in emerging economies, investment volatility is significantly larger than in advanced economies (Aguiar and Gopinath (2007)).
The government consumption[24] is assumed to be exogenous, and the gap equation follows an autoregressive process:

$$\widehat{gc}_t = a_{24}\widehat{gc}_{t-1} + \varepsilon_t^{\widehat{gc}} \tag{16}$$

In relation to foreign trade, the export gap ($\hat{x}$) follows an autoregressive process, incorporating a fundamental component tied to foreign demand ($\hat{y}^w$) and the difference between the real effective exchange rate gap ($\widehat{reer}$) and the real price of export ($\widehat{rp}^X$)

$$\hat{x}_t = a_{25}\hat{x}_{t-1} + a_{26}(\widehat{reer}_t - a_{27}\widehat{rp}_t^X) + a_{28}\hat{y}_t^w + \varepsilon_t^{\hat{x}} \tag{17}$$

The export gap equation is derived from the neoclassical production function, incorporating key features of open economy models. The demand for exports depends on foreign output. Furthermore, export sensitivity is also affected by relative price differentials (a_{25}). However, the elasticity is relatively lower due to the significant contribution of a semiconductor sector. Consequently, a depreciating real exchange rate (i.e., improvement of competitiveness) does not stimulate exports as much as in other open economies with a more diversified export industry.

The import gap (to capture cyclical import dynamics) is expressed as follows:

$$\widehat{m}_t = a_{29}\widehat{m}_{t-1} + (1 - a_{29})\begin{pmatrix} a_{30}(\hat{c}_t - a_{31}\widehat{reer}_t) \\ +a_{32}\widehat{gc}_t + a_{33}\widehat{inv}_t \\ +(1 - a_{30} - a_{32} - a_{33})\hat{x}_t \end{pmatrix} + \varepsilon_t^{\widehat{m}} \tag{18}$$

24 The System of National Accounts (SNA) encompasses the total public consumption of the public sector, including both the central government and municipalities. In contrast, the Government Finance Statistics (GFS) focuses solely on central government spending. In the calculation of GDP identities, we utilize the government consumption from SNA.

Under a small open economy and a relatively high share of foreign goods in final consumption, the import gap depends on the expenditure gaps of consumption ($\hat{c}$), investment ($\widehat{inv}$), government absorption ($\widehat{gc}$), and exports ($\hat{x}$). We assume that in the case of imported consumption, the household can substitute foreign goods with domestic ones (through the expenditure switching channel). Therefore, the consumption gap is adjusted by the real exchange rate gap ($\widehat{reer}$). With real exchange rate depreciation, households decrease their import, generating more demand for domestic goods, and the improvement in net exports increases the output gap. However, the effectiveness of this expenditure switching is limited (the coefficient a_{31} is relatively small). Furthermore, for other imported final goods such as government consumption, exports, or investment, there is no expenditure switching, as these goods are assumed to be sector-specific and are imported from trading partners not available in the domestic economy.[25]

The autoregressive term captures adjustment costs that result in a gradual accommodation in import demand. However, due to large, mostly idiosyncratic shocks beyond demand factors, there are unexplained temporary components in imports. The coefficients a_{30}, a_{32} and a_{33} are calibrated based on the input-output (I/O) tables, as discussed in the Calibration section below. These coefficients capture the consistent flow of goods and services in accordance with the System of National Accounts (SNA).[26]

Trends of the GDP expenditure side components

The trend equations align with the FINEX model (Berg et al., 2023), establishing trends to uphold constant nominal GDP ratios along the steady-state balanced growth path. Consequently, these trends impose constraints on real growth values. Additionally, error correction terms are incorporated to facilitate a return to the steady-state nominal GDP ratio following a trend-shifting shock. The trend equation for $j = \{c,\ inv,\ gc,\ x\}$ is expressed as:

$$\Delta\bar{j}_t = \rho^{\Delta\bar{j}}\Delta\bar{j}_{t-1} + (1-\rho^{\Delta\bar{j}})\left(\Delta\overline{rp}_t^{y} + \Delta\bar{y}_t - \Delta\overline{rp}_t^{j}\right) - \delta^{\Delta\bar{j}}(j_t^{rat} - j^{rat,SS}) + \varepsilon_t^{\Delta\bar{j}} \tag{19}$$

The equation is characterized by an autoregressive process. The second term defines the steady-state real growth rate for the corresponding expenditure item, whereas the third term introduces an error correction component, gradually guiding the trend back to the growth rate consistent with the steady-state nominal GDP ratio. Simultaneously, the real price trends ($\Delta\overline{rp}^{j}$) are derived in conjunction with the GDP deflators.[27]

The model pins down the potential GDP growth through the following autoregressive process:

$$\Delta\bar{y}_t = \rho^{\Delta\bar{y}}\Delta\bar{y}_{t-1} + (1-\rho^{\Delta\bar{y}})\Delta y^{SS} + \varepsilon_t^{\Delta\bar{y}} \tag{20}$$

[25] In our model, formally, we do not explicitly distinguish between producer currency pricing (PCP) and dominant currency pricing (DCP). However, implicitly, we assume that exporters follow DCP, as they exhibit resistance to real exchange rate movements. This is indicated by the fact that exporters' import demand remains independent of exchange rate fluctuations. Additionally, in the export demand curve, the low coefficient for the real exchange rate suggests that most exporters set their optimal prices in foreign currency and do not adjust them based on domestic currency fluctuations.

[26] The I/O tables describe how different branches and sectors of the economy contribute to total production, gross domestic product (GDP), and the final use of income (GDP expenditure side). These tables also quantify the import demand of each branch. Assuming a linear production technology, the import demand in final usage can be calculated from the total import demand of the branches and their contributions to final use.

[27] Berg et al. (2023) assumes further linkages and factors determining the trend of each GDP expenditure. components. Because of the high volatility of the Philippines data, we do not assume further link among the trend variables.

With the potential GDP growth fixed in eq. 20, the domestic demand and export components are computed using eq. 19, while eq. 3 is employed to determine the real growth rate of the import trend.

3.1.2 Inflation and Aggregate Supply

The model allows for a range of empirically relevant nominal and real rigidities, often incorporated into central bank policy models, including price and wage stickiness. An important topic at this juncture, pertaining to destabilized inflation expectations risks and credibility concerns.

The headline inflation represented by the percentage changes in the consumer price index, in PAMPh is decomposed into core, food, and energy components. Core inflation aims to capture underlying inflationary pressure aligned with the cyclical position of the economy, while the latter two components describe non-core prices primarily influenced by international commodity prices and exchange rate fluctuations.

The consumer price index (cpi) identity is written as

$$cpi_t = w^{cpi,food} cpi_t^{food} + w^{cpi,energy} cpi_t^{energy} + \left(1 - w^{cpi,food} - w^{cpi,energy}\right) cpi_t^{core} + \varepsilon_t^{cpi} \tag{21}$$

Here, cpi^{food}, cpi^{energy} and cpi^{core} represent the food, energy, and core consumer prices respectively, with $w^{cpi,i}$ denoting the corresponding weights from the *Classification of Individual Consumption According to Purpose* (COICOP) statistics. Despite the assumption of fixed weights in the CPI basket, these weights in COICOP statistics vary over time. The error term absorbs any unmodeled historical changes in weights.

PAMPh2.0 follows the FINEX model with the incorporation of real prices. All price levels are normalized by the headline CPI, expressing them in real terms, which can be further divided into gap and trend components. The trends are modeled as an exogenous autoregressive process, capturing permanent and medium-term price growth that exceeds the headline inflation target. The gaps are determined from the identities and fed into the Phillips curves. Relative price gaps are utilized to express pass-through among inflation components and assist in defining real marginal costs accurately.

Core inflation meets the essential criteria of the open-economy version of the New Keynesian Phillips curve, shaping inflation dynamics through the interplay of expectations and production costs:

$$\Delta cpi_t^{core} = b_1 \Delta cpi_{t-1}^{core} + (1 - b_1) \Delta cpi_{t+1}^{core} + rmc_t^{core} + \varepsilon_t^{\Delta cpi^{core}} \tag{22}$$

It is driven by a hybrid of backward and forward-looking expectations, real marginal costs (rmc^{core}), and the cost-push shock ($\varepsilon^{\Delta cpi^{core}}$). The expectations are endogenously determined by the series of real marginal costs and shocks. Real marginal costs encompass the cyclical position of the real economy, imported foreign inflation, and the inflationary pressure from non-core items. The cost function is expressed as:

$$rmc_t^{core} = b_2 \hat{y}_t + b_3 (\widehat{reer}_t - \widehat{rp}_t^{core}) + b_4 \left(\widehat{rp}_t^{energy} - \widehat{rp}_t^{core}\right) + b_5 \left(\widehat{rp}_t^{food} - \widehat{rp}_t^{core}\right) + b_6 \widehat{wr}_t \tag{23}$$

The output gap serves as a proxy for domestic demand-side inflationary pressures, the second term reflects the international spillover effect of foreign inflation, and the last two terms involve the pass-through from non-core inflation to core inflation. Each term is formulated as the difference between the real effective exchange rate ($\widehat{reer}$) or real price of non-core items ($\widehat{rp}^{energy}$ or $\widehat{rp}^{food}$) and the real price of core ($\widehat{rp}^{core}$). These terms can be derived from nominal price differentials (see Al-Sharkas et al. (2023)), constituting the real marginal costs in the core-sector. The extension of the labor market implies that the real wage ($\widehat{wr}$) also contributes to firms' production costs and, consequently, to the real marginal cost function.

The domestic prices of food and energy, considered as non-core items, adhere to the New Keynesian theory. The Phillips curve for these items incorporates both backward and forward-looking expectations, along with cost terms:

$$\begin{aligned}\Delta cpi_t^{food} &= b_7 \Delta cpi_{t-1}^{food} + (1-b_7)\mathrm{E}_t cpi_{t+1}^{food} \\ &\quad + b_8\left(\widehat{rpc}_t^{food} + \widehat{re}_t^{US} - \widehat{rp}_t^{food}\right) + \varepsilon_t^{\Delta cpi^{food}}\end{aligned} \tag{24}$$

$$\begin{aligned}\Delta cpi_t^{energy} &= b_9 \Delta cpi_{t-1}^{energy} + (1-b_9)\mathrm{E}_t \Delta cpi_{t+1}^{energy} \\ &\quad + b_{10}\left(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^{energy}\right) + \varepsilon_t^{\Delta cpi^{energy}}\end{aligned} \tag{25}$$

The cost terms are primarily driven by the international commodity prices adjusted by the bilateral exchange rate (USD vis a vis PHL, $\widehat{re}_t^{US}$) and deflated by the domestic commodity price level, and, as secondary, their own shocks. Energy prices are largely determined by the international Brent oil price, given that the Philippines is a net-oil importer. However, the idiosyncratic shock introduces additional, mostly domestic-driven, elements such as electricity, water and gas components in the energy CPI basket. The international commodity food price basket includes different products and different weightings; thus, the shock term absorbs these country-specific characteristics in domestic food prices.

Moreover, in alignment with Berg et al. (2023), the model incorporates Phillips curves for GDP-expenditure price deflators. These are interconnected with the respective expenditure gaps and the transmission / pass-through of imported inflationary pressures or international commodity prices. For details, see Appendix B.

3.1.3 Banking Sector

The model incorporates two types of credit—credit for households and credit for firms. Additionally, the model makes a clear distinction between the stock of credit (outstanding credit) and the flow of credit (newly issued bank loans).

The outstanding credit ratio, cr^{rat}, is calculated as a fraction of the outstanding credit in the previous period and the newly issued credit ratio, ncr^{rat}:

$$cr_t^{j,rat} = \frac{\left(1-\delta^j\right) cr_{t-1}^{j,rat}}{\exp\left(\dfrac{\Delta \overline{gdp}_t^{nom}}{400}\right)} + ncr_t^{j,rat} + \varepsilon_t^{cr\,j,rat} \tag{26}$$

δ^j represents the share of outstanding credit that matured. Outstanding credit is further categorized into credit for households and firms, denoted by the index $j = \{h, f\}$. Both credit ratios, outstanding and newly issued, are expressed as shares of nominal potential GDP (denoted by $\overline{gdp}^{nom}$)[28]. $\varepsilon^{cr^{rat}}$ denotes a shock.

The newly issued credit ratios are decomposed into a trend and a gap. The trend ratios are stochastic but returning gradually to a calibrated steady-state. The newly issued loan ratios in gap terms define the credit cycle. The shape of the gap equations differs for households and firms, reflecting the distinct purposes of loans.

Households demand credit primarily for consumption. The newly issued credit for household gap, denoted as $\widehat{ncr}^{h,rat}$, is as follows:

$$\widehat{ncr}_t^{h,rat} = \rho^{\widehat{ncr}^{h,rat}} \widehat{ncr}_{t-1}^{h,rat} + \alpha^{\widehat{ncr}^{h,rat}} \hat{c}_t - \beta^{\widehat{ncr}^{h,rat}} \hat{r}_t^L + \varepsilon_t^{\widehat{ncr}^{h,rat}} \tag{27}$$

$\hat{c}$ represents a private consumption gap, $\hat{r}^L$ is a real lending rate gap, and $\varepsilon^{\widehat{ncr}^{h,rat}}$ is a credit demand shock. Eq. 27 assumes that household loans are primarily utilized for consumption. Increased consumption, indicated by a positive consumption gap, results in higher demand for household credit. Conversely, a higher cost of credit, denoted by a positive real interest rate gap, implies a lower demand for credit.

Firms demand credit for investment in real estate, using housing as collateral. The newly issued credit gap equation for firms, $\widehat{ncr}^{f,rat}$, is:

$$\begin{aligned}\widehat{ncr}_t^{f,rat} &= \rho^{\widehat{ncr}^{f,rat}} \widehat{ncr}_{t-1}^{f,rat} \\ &+ \left(1 - \rho^{\widehat{ncr}^{f,rat}}\right) \max\left\{ltv\left(\widehat{zh}_t - \widehat{zh}_{t-1} - \beta^{\widehat{ncr}^{f,rat}} \hat{r}_t^L\right), -\widehat{ncr}^{f,ss,rat}\right\} \\ &+ \varepsilon_t^{\widehat{ncr}^{f,rat}}\end{aligned} \tag{28}$$

where $\widehat{zh}$ represents a relative house price gap, $ncr^{f,ss,rat}$ is the steady state share of newly issued credit to firms, ltv is the loan to value ratio, and $\varepsilon^{\widehat{ncr}^{f,rat}}$ is a firm credit demand shock. The real lending rate gap serves as a measure of lending costs. Due to data availability constraints and for the sake of simplicity and tractability, the same real lending rate is utilized for households.

The demand for firm credit is influenced by changes in relative house prices, which serve as collateral, and the cost of credit. Firms' credit is assumed to always be constrained by the value of collateral. Increasing property prices alleviate the binding constraint on the amount of credit; however, the gain in terms of collateral value is rescaled by the loan-to-value ratio (ltv). Additionally, demand for newly issued loans is enforced to be only positive, not negative. This constraint is implemented using the maximum function in eq.28, preventing any potential decline of demand below the steady-state share of newly issued loans for firms.

[28] The share on potential nominal GDP is used here to ensure that all gaps exhibit the same unit of measure, i.e. percentage deviation from potential.

The real lending rate as price of credit is computed from the nominal lending rate by substrating expected inflation. The nominal lending rate, denoted as rs^L, has a 1-year maturity and is tied to the rate on one-year government bonds:

$$rs_t^L = \rho^{rs^L} rs_{t-1}^L + \left(1 - \rho^{rs^L}\right)\left(rs_t^{1Y} + prem_t^c\right) + \varepsilon_t^{rs^L} \tag{29}$$

rs^{1Y} is one-year lending rate, $prem^c$ denotes credit premium, and ε^{rs^L} represents a shock to the lending rate.

The credit premium is endogenous and comprises two parts:

$$prem_t^c = prem_t^{cc} + bspread_t \tag{30}$$

Firstly, $prem^{cc}$ represents the risk component of the credit premium, necessary to factor in the probability of borrower default, and is determined by:

$$\begin{aligned} prem_t^{cc} = {} & \rho^{prem^{cc}} prem_{t-1}^{cc} \\ & + \left(1 - \rho^{prem^{cc}}\right)\left(-\alpha_1^{prem,cc} \mathrm{E}_t \hat{y}_{t+1} + \alpha_2^{prem,cc} \widehat{prem}_t + prem^{ss,cc}\right) \\ & + \varepsilon_t^{prem^{cc}} \end{aligned} \tag{31}$$

It assumes that the credit premium is negatively linked to the output gap, $\hat{y}$, and positively to the country risk premium gap, $\widehat{prem}$. The negative impact of the output gap on the credit premium reflects the financial accelerator mechanism.

Secondly, the regulatory component of the credit premium denoted as $bspread$, represents the spread margin that banks add to meet capital requirements (discussed in detail below).

House prices are expressed in relative terms with respect to the GDP deflator. The relative price is further decomposed into a trend, denoted as $\overline{zh}$, and a gap, represented by $\widehat{zh}$.

$$\widehat{zh}_t = \rho^{\widehat{zh}} \widehat{zh}_{t-1} + \left(1 - \rho^{\widehat{zh}}\right)\beta^{\widehat{zh}} \mathrm{E}_t \widehat{zh}_{t+1} + \alpha_1^{\widehat{zh}}\left(\hat{y}_t - \alpha_2^{\widehat{zh}} \hat{r}_t^L\right) + \varepsilon_t^{\widehat{zh}} \tag{32}$$

$\widehat{zh}$ is determined by past and expected relative house prices, the business cycle position affected by the output gap, and the suppressing effects of the real lending rate gap.

Moving to banks, U/KBs are presumed to provide credit to the economy, with their assets assumed to remain relatively stable in relation to nominal potential GDP. This assumption is captured by the following equation:

$$ta_t^{rat} = cr_t^{rat} + ta^{wedge} + \varepsilon_t^{ta} \tag{33}$$

Most assets are associated with the outstanding credit extended by banks, cr^{rat}, and this portion is explicitly modeled. The remaining component, ta^{wedge}, involves simple rescaling to align the nominal share with the data. To account for data affected by revaluation, a shock, ε^{ta}, is introduced into the equation.

Commercial banks are required to maintain capital, which is represented as the ratio of capital to bank assets, denoted as bc^{ta}. Capital accumulation is determined by the following process:

$$bc_t^{ta} = \frac{bc_{t-1}^{ta}}{\exp\left(\frac{\Delta ta_t}{400}\right)} + roa_t - div_t^{ta} + \varepsilon_t^{bc} \tag{34}$$

where ta represents total assets, roa return on assets, div^{ta} share of dividends on total assets, and ε^{bc} a shock to capital accumulation. Division by 400 transforms annualized growth of total assets to non-annualized qoq growth needed to capture bank capital accumulation as a share on total assets. According to eq.34, banks can accumulate capital in two ways: new capital can be issued, represented by the shock to capital accumulation, or capital can be accumulated from profits, increasing the return on assets.

The return on assets, roa, is estimated as the difference between the lending rate (in gauging profits) and the policy rate:

$$roa_t = (1 - rrr)\frac{(rs_t^L - rs_t)}{4} + cost^{adj} \tag{35}$$

The added constant term, $cost^{adj}$, accounts for the return/cost of other assets. The lending rate is determined by commercial banks, and the model assumes that these banks have the ability to adjust the lending rate spread, $bspread$, to accumulate capital if necessary.

$$bspread_t = -f_o\left(bc_t^{ta} - bc_t^{ta,TAR}\right) + \varepsilon_t^{bspread} \tag{36}$$

$bc_t^{ta,TAR}$ is the target level for capital on total assets and $\varepsilon^{bspread}$ is a shock to the spread set by commercial banks.

A third way how commercial banks can accumulate capital is by reducing dividend payments:

$$div_t^{ta} = \max\left\{(1 - rrr)div^{ss,ta} + bc_t^{ta} - bc_t^{ta,TAR}, 0\right\} + \varepsilon_t^{div} \tag{37}$$

The function is nonlinear and ensures that no dividends are paid if the capital ratio (capital/assets) falls below the required target, and positive dividends are paid if the capital ratio is above the target. When capital requirements are met, dividends at the level $div^{ss,ta}$ are paid.

3.2 External Balance

In the extended QPM, the BoP constraint is modeled explicitly, represented by the identity eq.38. The current account (net cross-border flows of goods and services) matches the financial account (net flows of financial claims)—generically, exports less imports together with private financial flows less FX purchases must equal zero. As highlighted in Berg et al. (2023), the PAMPh2.0 country application of FINEX embeds the structure of endogenous private financial flows (i.e., portfolio flows and cross border bank lending) responding to the uncovered interest parity (UIP) premium.[29]

$$0 = ca_t^{rat} + fa_t^{rat} \tag{38}$$

The current account is derived from the net export position (nx^{rat}), remittance inflows ($remit^{rat}$) in reference to income flow from Filipinos working abroad, interest payments on foreign currency (FCY) denominated public debt position ($intcost^{f,rat}$), and other private foreign income (oth^{rat}) which includes foreign interest payments on private net foreign asset and foreign direct investments:

$$ca_t^{rat} = nx_t^{rat} + remit_t^{rat} - intcost_t^{f,rat} + oth_t^{rat} \tag{39}$$

As defined earlier, '*rat*' superscript refers to variables expressed as a ratio of nominal GDP.

Financial account inflows (fa^{rat}) are decomposed in eq.38, in helping determine the economy's external financing needs commensurately with macroeconomic conditions:

$$fa_t^{rat} = nfp_t^{rat} - fxi_t^{rat} - fxa_t^{rat} + \left(debt1Y_t^{f,rat} - debt1Y_{t-4}^{f.rat} \cdot \frac{\exp\left(\frac{\Delta^4 e_t}{100}\right)}{\exp\left(\frac{\Delta^4 gdp_t^{nom}}{100}\right)} \right) \tag{40}$$

Private sector financial inflows (nfp^{rat}) are arrived at (residually) under derived fxi^{rat}, $fxa^{rat}$and the renewal of expired $debt1Y^{f,rat}$[30]. The term $\exp(\;)$ represents the exponential function. Since the terms are expressed in terms of period-t nominal GDP, the four-period lag term of foreign currency-denominated public debt is rescaled by the year-on-year nominal GDP growth and nominal depreciation.

Trend versions of eq.39 (defining for instance the equilibrium current account balance) and eq.40, and components therein (all denoted by bars), are defined below, in tracking the trend and gap parts of the current account and financial account balances.

The following equations describe the trend and cyclical position of financial inflows:

$$\overline{nfp}_t^{rat} = nfp^{SS} + \frac{h_2}{1-h_3} \cdot \left(\overline{prem}_t - h_3 \overline{prem}_{t-1} - (1-h_3) prem^{SS} - \varepsilon_t^{\overline{prem}}\right) \tag{41}$$

$$\widehat{nfp}_t^{rat} = h_1 \cdot \left(\widehat{prem}_t - \varepsilon_t^{\widehat{prem}}\right) \tag{42}$$

[29] The specification of the UIP premium is consistent with that in Basu et al. (2020, 2023) and Adrian et al. (2021), though it is more general in one respect. In the IPF papers, it is the *stock* of NFA that determines the UIP premium. In FINEX, the UIP premium depends both on the size of portfolio *flows* and, through their effect on investors' required rate of return, on the *stock* of public debt, the NFA position, and reserves. This hybrid formulation captures both effects and thus fits the data better and lends itself to producing plausible forecasts.

[30] Eq.40 reflects both (i) a demand curve (setting aside net exports which is reflected in eq. 39) as an implicit function of the policy interest rate and the exchange rate, as well as a (ii) supply function primarily focused on the (endogenous) capital flows captured (by and large) in the nfp_t^{rat} term which allows discussing UIP premium and investors tying premium to exogenous risk-on-off idiosyncratic term and a state-contingent component related to public debt (to GDP), reserves and private NFA.

The terms $\overline{prem}$ and $\widehat{prem}$ denote country risk premium trend and gap positions respectively, and the $\varepsilon^{\overline{prem}}$ and $\varepsilon^{\widehat{prem}}$ are the corresponding shocks:

$$prem_t = \overline{prem}_t + \widehat{prem}_t \tag{43}$$

The total country risk premium feeds into the UIP condition. The UIP condition is the financial market equilibrium condition as the difference between the domestic (i_t^M) market interest rate and the foreign interest rate (i^{US}) is equal to the expected (nominal) exchange rate depreciation ($s_t^e - s_t$) adjusted by the country risk premium ($prem_t$). The fxi_t^{rat} term captures the impact of central bank FX intervention policies. As the BSP increases foreign reserves, it generates higher demand for foreign assets, leading to a rise in domestic interest rates. An exogenous (ε_t^s) risk-on/off term is captured so is the willingness of foreign investors to supply financing which falls with higher reserves (a state-contingent component).

$$i_t^M = i_t^{US} + prem_t + \xi \cdot fxi_t^{rat} + 4 \cdot (s_t^e - s_t) + \varepsilon_t^s \tag{44}$$

The expected nominal exchange rate is expressed as the weighted average of past and future nominal exchange rates:

$$s_t^e = \mu \mathrm{E}_t s_{t+1} + (1-\mu)\left(s_{t-1} + \frac{\Delta \bar{s}_t}{2}\right) \tag{45}$$

The UIP condition can be interpreted in a way that determines the short-run position of the nominal exchange rate, where the expected nominal exchange rate is a combination of forward and backward-looking terms.

3.3 Macroeconomic Policies

Extended QPMs motivated by the FINEX can accommodate a wide range of traditional and non-traditional policy instruments. The tools consist of a policy interest rate, FXI—to accumulate reserves and stabilize the exchange rate, MPMs, and CFMs, encompassing price-based and regulatory capital controls. BSP's primary instrument is the overnight reverse repurchase (RRP) rate, it has also the ability to deploy FXI, CFMs, and MPMs. These are typically utilized in situations in which conventional interest rate policy might be constrained, taking a pragmatic approach, rather than following an explicit framework. The BSP’s flexible exchange rate regime has always been the first line of defense against financial market volatility and global shocks. However, the BSP may transact in the FX market to ensure orderly market conditions and to reduce excessive short-term volatility that could potentially have an impact on inflation and inflation expectations. From a fiscal policy perspective, various revenue- and expenditure-based instruments are guided by deficit and debt anchors to stabilize deficits and public debt. Other idiosyncratic policy adjustments are also part of the policy toolkit.

3.3.1 Monetary Policy

An interest rate reaction function aims to stabilize inflation and the output gap. Planned foreign exchange purchases can accumulate reserves to reach a prudent level, while FX interventions can help mitigate disorderly market conditions caused by, abrupt capital outflows for example.[31] Both price-based and regulatory

[31] Per the IPF (2023), FX interventions are advisable when shocks are large, leading to significant premium deviations that pose risks to central bank objectives, provided FX interventions effectively support these goals. Interventions must avoid disrupting market efficiency or appearing to target exchange rate levels. However, the model does not account for sterilization costs associated with acquiring and holding FX assets.

CFMs can influence capital inflows directly. We describe the various instruments and channels pertinent to the specific policies and measures and highlight the interaction of policies in addressing trade-offs and reaching the central bank's macro-financial and price stability objectives.

The policy interest rate

The BSP operates under a flexible inflation-targeting regime. The policy rate follows a standard Taylor rule (eq.46); it reacts to expected deviations of annual CPI ($\Delta^4 cpi_{t+2}$) from the target(Δcpi^{TAR}) and to contemporaneous deviations of output from potential ($\hat{y}_t$).

$$i_t^{pol} = \gamma_1 i_{t-1}^{pol} + (1-\gamma_1) \cdot \left(\bar{r}_t + \mathrm{E}_t \Delta cpi_{t+1}^{TAR} + \gamma_2\left(\mathrm{E}_t \Delta^4 cpi_{t+2} - \mathrm{E}_t \Delta cpi_{t+2}^{TAR}\right) + \gamma_3 \hat{y}_t\right) + \varepsilon_t^{ipol} \quad (46)$$

The monetary rule also includes an autoregressive coefficient to prevent an immediate response of the policy rate, aligning with the historical volatility of the policy rate. Beyond the short-term horizon, the central bank sets the interest rate based on the neutral real interest rate and the inflation target. The shock to the policy rate (ε^{ipol}) allows for discretionary steps in monetary policy, deviating from systematic behavior.

The policy rate is translated to the market rates that affect the credit activity:

$$i_t^M = \gamma_4 i_{t-1}^M + (1-\gamma_4) i_t^{pol} + \varepsilon_t^M \quad (47)$$

The money market rate (i^M) is determined based on the policy rate, with some delay. The BSP has traditionally used the unsecured IBCL rate as its primary indicator to guide open market operations. However, with the implementation of variable-rate RRP auctions in September 2023, the model adopted the overnight RRP rate as its principal market rate.

Foreign reserves management

The central bank in the model can manage the FX reserves level, through FX interventions aimed at influencing conjunctural outcomes (including in response to disorderly market conditions or excessive exchange rate volatility, and destabilizing impact of potential sharp exchange rate movements on macroeconomic and price stability) and/or by conducting systematic reserve accumulation to build stocks (IMF 2023a).

${fxi_t}^{rat}$ is the central bank's sterilized intervention to buy/sell reserves as a response to economic conditions[32].

$$fxi_t^{rat} = \gamma_5 fxi_{t-1}^{rat} + (1-\gamma_5)\left(\gamma_6 \widehat{ca}_t^{rat} - \gamma_7 \widehat{fxres}_t^{ratimp}\right) - \gamma_8 \widehat{prem}_t - \gamma_9 \widehat{re}_t + \varepsilon_t^{fxi^{rat}} \quad (48)$$

Based on eq.48, such rule-based interventions respond to exchange rate misalignments arising from current account deficits or real exchange rate overvaluation (the second and fourth terms), and to an interest rate

[32] The FXI decision are often made at higher frequency indicators (e.g., daily), which come under the purview of FX operations teams and not the team supporting macro-financial policy advice using quarterly models to senior management. The PAMPh2.0, capturing the best fit to the macroeconomic data and historical policy decision, guides policy makers in term of principles for the use of FXI and it also ensures consistency between high-frequency FXI decision making and lower-frequency macro-financial modeling in quarterly quantitative frameworks in central banks.

differential (the third term) and captures money market disruptions reflected in the country risk premium. The first term allows for persistence. A discretionary FXI shock ($\varepsilon_t^{fxi^{rat}}$) allows for ad-hoc interventions. Rule (eq.48) is neither an optimal nor a systematic prescription for modeling FXI as a reaction function for the baseline projections and policy scenarios. From an operational perspective and model application, the rule is stylized and is meant to provide general guidance in demonstrating policy trade-offs and macroeconomic implications of various FX-intervention policies to specific shocks and its interactions with other policies monetary, macroprudential and fiscal policies.

In addition to FXI, the central bank uses FX accumulation (fxa_t^{rat}) to steer the stock of foreign reserves towards a desired level. In eq.49, it is assumed that the BSP establishes an exogenous target for the optimal level of FX reserves relative to monthly imports. The accumulation of FX reserves (fxa^{rat}) is then influenced by the response to the disparity between the actual FX reserves and the targeted threshold. Drawing from historical ARA-metric data, it is evident that the BSP has consistently maintained a substantial level of FX reserves. Since 2008, the ARA reserve ratio has consistently exceeded 150 percent. This ample reserve position has empowered the central bank to respond effectively to disorderly market conditions and external imbalances.

$$fxa_t^{rat} = \gamma_9 fxa_{t-1}^{rat} - (1-\gamma_9)\left(\overline{fxa}_t^{rat} + \gamma_{10}\widehat{fxres}_t^{ratimp}\right) + \varepsilon_t^{fxa^{rat}} \qquad (49)$$

$\widehat{fxres}^{ratimp}$ denotes the deviation of actual reserve in monthly imports from the targeted level, $\overline{fxa}^{rat}$ is the targeted reserve accumulation consistent with the FX reserve target. The central bank accumulates reserves, assumed in U.S. Tbills, where the total change of the FX reserve is the function of the sum of the intervention and accumulation, currency depreciation, and US Fed policy rate.

Eq.50 determines the reserve accumulation. A trend version of this equation underpinned by a fixed reserve target, determines the targeted FX accumulation:

$$fxres_t^{rat} = fxi_t^{rat} + fxa_t^{rat} + \left(1 + \frac{i_{t-1}^{us}}{400}\right) fxres_{t-1}^{rat} \frac{\left(1 + \frac{\Delta e_t}{400}\right)}{\left(1 + \frac{\Delta gdp_t^{nom}}{400}\right)} \qquad (50)$$

Capital flow management

In the PAMPh framework, there is an option to incorporate CFMs, which can isolate domestic financial markets from global influences. These CFMs represent a potential strategy for stemming capital outflows and, consequently, shielding or alleviating the real economic repercussions of external shocks. Building on the framework established by Berg et al. (2023), we define two primary types of CFMs: (1) administrative restrictions and (2) capital inflow taxes.

Administrative restrictions, and in severe instances, outright bans, on cross-border transactions, denoted by ($\tau_t^{CFM,Admin}$), serve to diminish the sensitivity of endogenous capital flows or the private sector's foreign financing requirements to the UIP premium ($\widehat{prem}$). Implicit in this approach is the imposition of limits on banks' unhedged foreign exchange positions or foreign borrowing through administrative CFMs.
Capital inflow taxes elevate the cost of capital inflows. This characterization of CFMs is particularly relevant for market-based measures, such as imposing requirements to hold a portion of capital inflows as unremunerated

reserves. These measures effectively heighten the excess return demanded by investors. We denote the capital flow CFM tax as ($\tau^{CFM,flow}$).

Formally, considering CFMs, eq.42 is adjusted as follows for $\widehat{nfp}^{rat}$:

$$\widehat{nfp}_t^{rat} = h_1 \cdot \left(1 - \tau_t^{CFM,Admin}\right) \cdot \left(\widehat{prem}_t - \left(\tau_t^{CFM,flow} - \tau^{CFM,flow,SS}\right) - \varepsilon_t^{\widehat{prem}}\right) \quad (51)$$

And correspondingly eq.41 for $\overline{nfp}^{rat}$ and $\overline{prem}$:

$$\overline{nfp}_t^{rat} = nfp^{SS} + \frac{h_2 \cdot \left(1 - \tau_t^{CFM,Admin}\right)}{1 - h_3} \cdot \left(\overline{prem}_t - h_3 \overline{prem}_{t-1} - (1 - h_3) prem^{SS} - \varepsilon_t^{\overline{prem}}\right) \quad (52)$$

CFMs, by restricting access to foreign financial markets (and potentially disconnecting domestic financial markets in extreme scenarios), exacerbate market shallowness. This is achieved by diminishing further the elasticity between the risk premium and the supply of private sector foreign financing. Consequently, CFMs can serve as an effective complement to FXI in mitigating nominal exchange rate pressures.

3.3.2 Macroprudential Policy

Banks adhere to regulatory macroprudential requirements defined by the ratio of capital to total assets. The ratio does not use risk-weighted assets and is simply taken to be a leverage ratio, i.e., capital to assets.

The target for the leverage ratio (bc^{TAR}) is either maintained as a constant or set in a countercyclical fashion to smooth the credit cycle:

$$bc_t^{ta,TAR} = \rho^{bc^{ta,TAR}} bc_{t-1}^{ta,TAR} + \left(1 - \rho^{bc^{ta,TAR}}\right)\left(bc^{ss,ta,rat} + \phi(cr_t^{rat} - cr^{ss,rat})\right) + \varepsilon_t^{bc^{ta,TAR}} \quad (53)$$

bc_{SS}^{TAR} represents the steady state level of the leverage ratio, $\rho^{bc^{TAR}}$ indicates the degree of persistency in setting the instrument, and $\varepsilon^{bc^{TAR}}$ represents a shock to the target level. The parameter ϕ indexes the strength of policy countercyclicality.

The structure of the above equation permits two modes of macroprudential policy—passive and active. By setting $\rho^{bc^{TAR}}$ to 1, the target ratio remains constant, indicating that macroprudential policy does not respond to the credit cycle. Conversely, setting $\rho^{bc^{TAR}}$ lower than one, along with nonzero ϕ, implies active macroprudential policy aimed at smoothing the credit cycle.

3.3.3 Fiscal Policy

Fiscal policy exerts influence over the short and medium-term trajectory of the real economy, inflationary pressures, and subsequently affects monetary policy decisions through various channels. In PAMPh2.0, we distinguish between different expenditure categories (such as current and capital expenditures, as well as financial transfers to households) and assume a single revenue source. The allocation of expenditures and revenue choices can have distinct implications for economic behavior and the response of monetary policy. Typically, expansionary fiscal expenditures tend to spur higher economic growth at the expense of inflationary pressures, necessitating a response from the central bank. However, the inflationary impact of fiscal spending hinges on the government's choice of instrument—revenue mobilization or tax increases may initially dampen demand but ultimately aid in reducing public debt and foreign indebtedness, thereby contributing to lower country risk premiums and more accommodative medium-term monetary conditions. Furthermore, the interest rate set by the central bank can constrain the scope of fiscal policy. In environments characterized by higher inflation and interest rates, government debt service costs escalate, potentially challenging debt sustainability and prompting fiscal policy adjustments to generate surpluses or negative stimulus.

In this subsection, we explore the fundamental characteristics of the fiscal block and underscore the intricate interplay between fiscal and monetary policies.

As mentioned, the fiscal block aims to provide a simple yet empirically realistic account of government spending and revenue streams as well as government spending multipliers. In PAMPh, the fiscal block parsimoniously describes the government's main objective, which is achieving and maintaining the targeted public debt level.[33] The total debt target is exogenously given as

$$debt_t^{rat,TAR} = \rho^{debt^{rat,TAR}} debt_{t-1}^{rat,TAR} + \left(1 - \rho^{debt^{rat,TAR}}\right) debt^{rat,SS} + \varepsilon_t^{debt^{rat,TAR}} \tag{54}$$

The public debt can be further decomposed into local currency nominated (LCY) and foreign currency nominated (FCY) parts (see Berg et al. (2023), and Al-Sharkas et al. (2023)). We assume a one-year maturity for the public debt for both FCY and LCY debt. New debt issuance follows the renewal of the expired debt level and the proportional financing of fiscal deficits. Meanwhile, total deficit (def^{rat}) is given by the primary deficit ($\text{prim}def^{rat}$, expenditures minus revenues) and the interest rate cost ($intcost^{rat}$, debt service of the FCY and LCY debts):

$$def_t^{rat} = primdef_t^{rat} + intcost_t^{rat} + \varepsilon_t^{def^{rat}} \tag{55}$$

The government sets the structural deficit to anchor the public debt level around the target, considering that primary deficits are influenced by the economy's cyclical position. Hence, $defstruct^{rat}$ represents the structural (cyclically adjusted) component, while $defcycle^{rat}$ captures the cyclical part of the primary deficit:

$$primdef_t^{rat} = defstruct_t^{rat} + defcycle_t^{rat} \tag{56}$$

The cyclical part of the primary deficit follows a simple rule of thumb and links the budget position to the output gap:

$$defcycle_t^{rat} = -f_1 \hat{y}_t + \varepsilon_t^{defcycle^{rat}} \tag{57}$$

[33] In PAMPh, the accumulation of domestic bonds by domestic households is not explicitly depicted as in DSGE models. Consequently, the concept of Ricardian equivalence, which hinges on the assumption that individuals anticipate future tax liabilities and adjust their consumption accordingly, does not influence the determination of fiscal multipliers. However, the potency of the fiscal multiplier is contingent upon the vigor of the income channel, as encapsulated in eq.4 by the coefficients a_6, a_9 and a_{10}.

where the negative sign is consistent with a common stylized fact: during economic upswings (positive output gap), the government tends to collect more revenues or needs to spend less on social expenditures and benefits, automatically generating a better deficit position and building buffers for bad times. The structural balance is determined by the fiscal rule that has two objectives:

$$defstruct_t^{rat} = \rho_{fp}(defstruct_{t-1}^{rat} - f_2\hat{y}_t) + (1-\rho_{fp})\left(defstruct_t^{rat,TAR} - f_3\widehat{debt}_t^{rat}\right) + \varepsilon_t^{defstruct^{rat}} \quad (58)$$

As the primary objective, the government aims to stabilize the debt level, responding to the deviation from the targeted level ($\widehat{debt}^{rat}$) until the debt reaches the target. As a second objective, the government also endeavors to support real economic activity by smoothing the cyclical position of the economy, maintaining GDP close to the potential level through countercyclical policies. In cases where the output gap position is negative, this approach permits a higher deficit, thereby minimizing the real economic sacrifice.

In light of the detailed primary deficit, the government must determine the instrument to be employed in achieving its fiscal objective. PAMPh2.0 provides a diverse set of instruments, including revenues (rev^{rat}), financial transfers (tr^{rat}), government current expenditures[34] (gc^{rat}), and government capital expenditures (gi^{rat}):

$$primdef_t^{rat} = gc_t^{rat} + gi_t^{rat} + tr_t^{rat} - rev_t^{rat} \quad (59)$$

In our current calibration, it is assumed that the revenues automatically adjust to changes in the primary deficit, while the other components are exogenously determined by an autoregressive process. However, we are not limited to revenue as the sole instrument, and we can explore the impact of alternative consolidation strategies by employing different fiscal instruments. Furthermore, we can also compare the fiscal multipliers associated with various fiscal variables.

Debt service or interest expenditures are explicitly described in PAMPh 2.0 based on both domestic (LCY) and foreign (FCY) currency denominated debt. As a simplification, the 1-year maturity for both debts is assumed. The maturity transformation is based on the term structure of interest rates[35] described as follows:

$$i4_t^d = (1-w^c)\left(\frac{i_t + i_{t+1} + i_{t+2} + i_{t+3}}{4} + tprem_t^d\right) + w^c(\bar{\imath}_t + tprem^{d,ss}) \quad (60)$$

[34] The government current expenditures and the government consumption from the SNA are not equivalent. The former only encompasses expenditures of the central government, whereas the latter takes into account both central and local governments.

[35] The foreign interest rate cost is computed in a similar way.

where $tprem^d$ is the domestic term premium with steady-state denoted by $tprem^{d,ss}$, and $\bar{\imath}$ is the neutral level of interest rate computed as a sum of the natural rate of interest and the inflation target. The w_c assigns the share of concessional debt, and we implicitly assume that the interest rate of the concessional debt is fixed at the natural interest rate plus steady-state term premium. The term $tprem^d$ is set by the financial markets which considers the level of domestic debt compared to its steady-state:

$$\begin{aligned} tprem_t^d = \rho^{tprem^d} tprem_{t-1}^d + \left(1-\rho^{tprem^d}\right) tprem^{d,ss} \\ +g_2\left(debt_t^{d,rat} - debt^{d,rat,ss}\right) + \varepsilon_t^{tprem^{dom}} \end{aligned} \quad (61)$$

4. Model Properties, Calibration, and Historical Interpretation

PAMPh2.0 is, by design, a forecasting and policy analysis model. In this section, we demonstrate its use for this purpose, showing how it can provide a structural interpretation of the historical data, and help make policy-contingent forecasts and risk assessments. It highlights the range of fundamental and non-fundamental shocks. PAMPh2.0 can address and demonstrate policy interactions, taking into consideration specific (macroeconomics-financial) characteristics of the Philippines. Beyond single shocks and corresponding policy responses, the ability of PAMPh2.0 to incorporate complex shocks and analyze implications of combining traditional and non-traditional policy tools (FXI, CFMs, MPMs) is the hallmark of this practical policy model.

The subsections that follow aim to analyze the model's dynamic properties with various exercises. First, in Section 4.1 the impulse response analysis describes the agent's reaction to shocks and policy measures. As the next step, in Section 4.2, calibration and empirical validation demonstrate the model's goodness of fit of the actual data. Finally, Section 4.2.3, illustrates the model behavior through the recent estimation of the cyclical position and interpretation of the actual economic data.

4.1 Impulse Response and Scenario Analysis

The impulse response function describes the agent's reaction to different shocks and provides insight into the dynamic properties of the model. Further, these assessments illustrate the benefits and costs of the interaction of different policies under particular shocks. These are basic elements of different policy scenarios where impulse responses are combined. In the following exercise, we show how scenarios can be simulated and the implications of different policy responses.

All simulations start from the steady state, with shocks causing deviations of model variables from this equilibrium. The figures depict the agents' reactions and how the economy reverts to long-run equilibrium contingent upon a policy response. In all figures, variables are plotted as deviations from the initial steady-state equilibrium.[36] To illustrate, we showcase the effects of various scenarios, including the tightening policy by the US Fed with and without FX intervention and CFMs, an international food price shock linked to the *El Nino* phenomenon, a shock to private consumption, public debt consolidation, an increase in asset prices, and a wage shock.

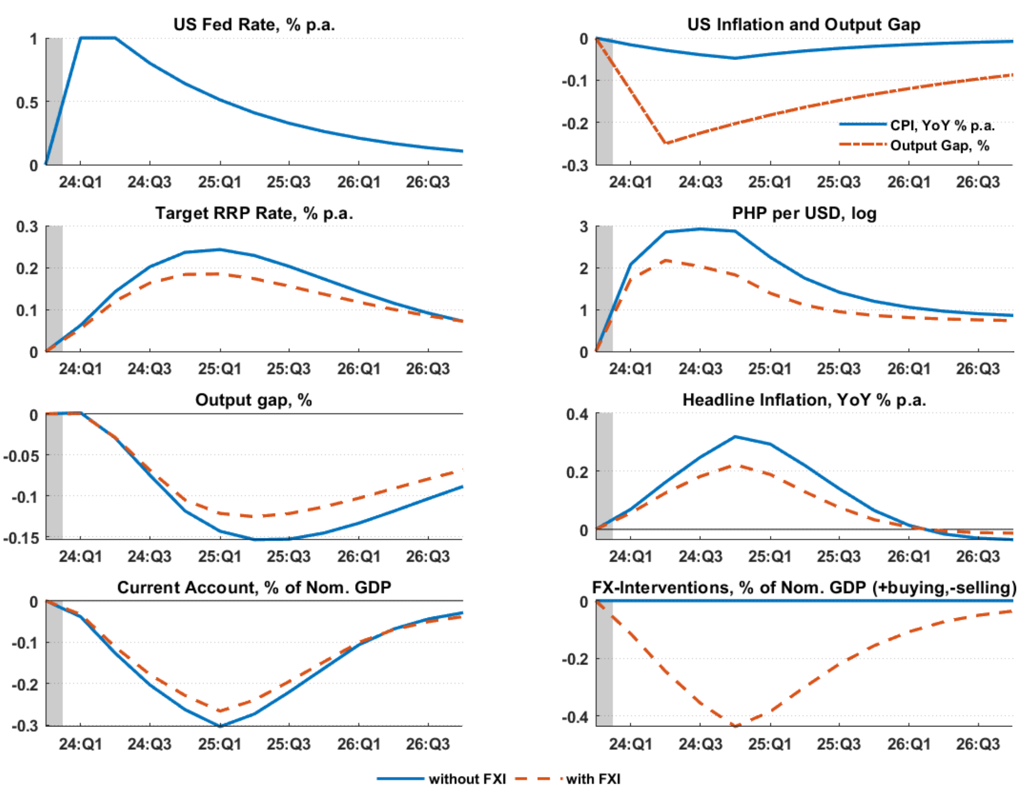
[36] A value of zero implies that it is equal to its initial steady state value along the Balanced Growth Path (BGP).

4.1.1 US Fed Monetary Tightening

In this analysis, depicted in Figure 4.1, we explore a scenario where the Fed opts for a more aggressive tightening of monetary conditions than necessary to maintain inflation at the target. Accordingly, this scenario involves an additional 100 basis point increase in the US Fed funds rate in the first quarter of 2024. The tightening of monetary conditions leads to a narrower foreign output gap and a slowdown in inflation. Additionally, the Fed's actions lower foreign demand, further dampening foreign inflation and triggering capital outflows from emerging markets, thereby exerting depreciation pressure on other currencies. Consequently, the peso begins to depreciate, contributing to imported inflationary pressures.

The BSP faces two options to counteract this depreciation pressure and maintain inflation at the target. In the scenario without FXI, monetary authorities opt to raise the policy interest rate to mitigate depreciation pressures, resulting in a contraction in domestic demand over the next four years, thereby returning inflation to the target by early 2026. Given the shallowness of markets and prevailing disorderly market conditions, FXI could serve as an effective tool to alleviate depreciation pressure on the peso and counteract imported inflationary pressures. This approach necessitates milder depreciation and lower policy rate increases, resulting in a more limited economic contraction. However, we consider that FXI diminishes the BSP's FX reserves and necessitates adequate sterilization capacities; otherwise, the decreasing liquidity could compromise the BSP's control over domestic money market conditions.

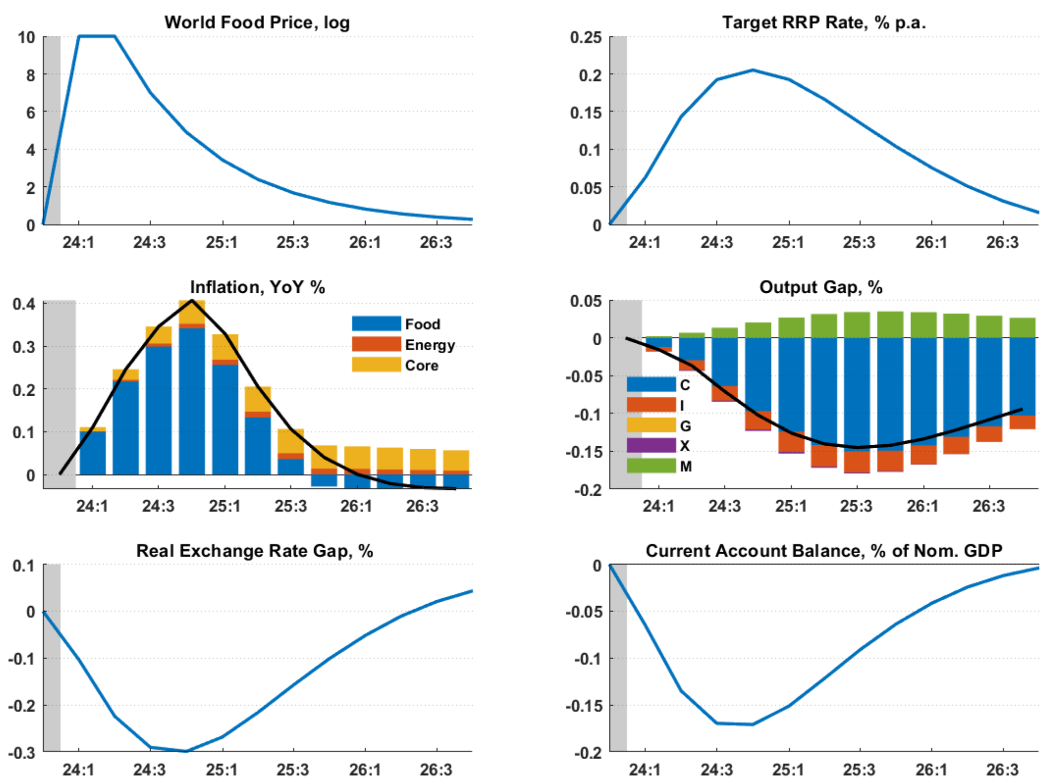
Figure 4.1: US Fed Monetary Tightening



4.1.2 International Food Price Shock Associated with *El Niño*

Figure 4.2 portrays the short-term repercussions of climate change and the *El Niño* phenomenon, exemplified by heightened volatility in international food prices. Policymakers must consider the risk of rising world food prices, which could trigger a second-round effect on domestic inflation.[37] In this scenario, world food prices surge by 10 percent compared to the baseline projection and remain elevated until 2025. This commodity price shock promptly impacts domestic non-core food prices, resulting in higher headline inflation, prompting a monetary policy response from the BSP. Monetary policy initiates a tightening cycle to mitigate the secondary effects on other inflation components. However, this action comes at the cost of economic deceleration, dragging down the output gap. Tighter monetary conditions lead to reduced consumption and deteriorating terms of trade. Moreover, the tightening cycle induces disinvestment due to the higher cost of funding. The escalating import prices exacerbate the current account deficit, while heightened external financing intensifies pressure on risk premiums and the currency.

Figure 4.2: International Food Price Shock during *El Niño*



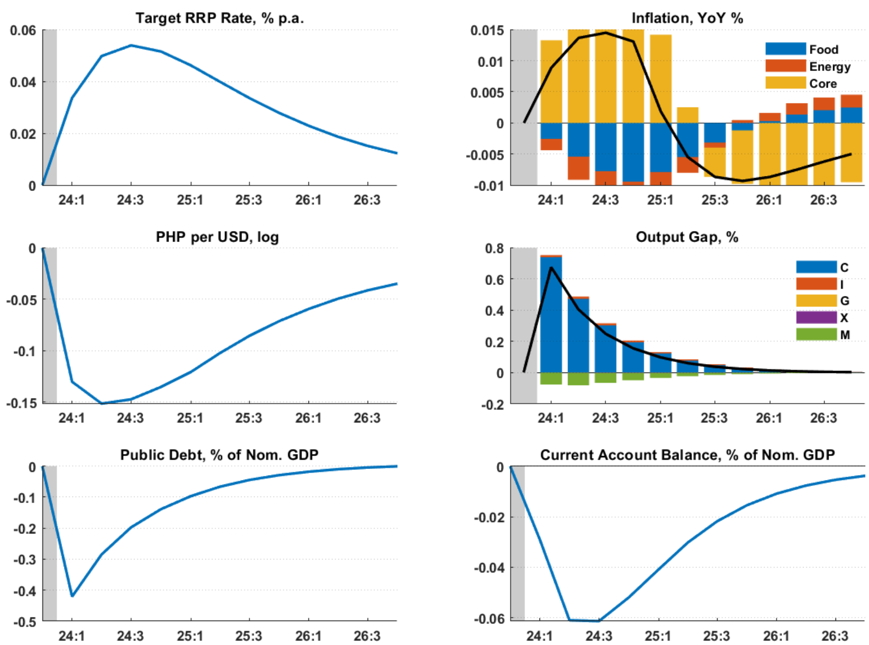
[37] In this simulation, we assume that the real price of food gap increases by 10 percentage points in the first two quarters of 2024 compared to the baseline scenario.

4.1.3 Private Consumption Shock

In this scenario, domestic households temporarily increase consumption by 1 percentage point in the first quarter of 2024, achieved through reallocating future income and acquiring additional private credits.[38] This surge in consumption demand elevates the output gap and intensifies inflationary pressures particularly core inflation, necessitating further tightening measures from the BSP. The central bank responds by raising the policy rate to temper the heightened domestic demand and maintain domestic inflation close to the target.

Assuming no changes in foreign interest rates, the increased domestic interest rate prompts nominal appreciation of the peso against the dollar, immediately curbing non-core inflation. Subsequently, as demand recedes and peso appreciation persists, non-core inflation remains below the target, leading to a decline in core inflation and headline inflation falling below the target. The demand shock stimulates higher nominal growth and government revenues, temporarily aiding in reducing public debt. However, the initial surge in demand fuels imports, exacerbating the economy's external position, heightening risk premiums, and constraining the monetary policy space to lower the nominal policy rate back to its original level.

Figure 4.3: Shock to Private Consumption



4.1.4 Public Debt Consolidation

In the aftermath of the COVID-19 shock, governments worldwide are endeavoring to restore gradually elevated public debt levels to those seen before the pandemic. In the case of the Philippines, the government has unveiled a gradual debt reduction strategy, aiming to reduce the deficit-to-GDP ratio to below 4 percent and lower public debt to about 56 percent of GDP by 2028. In our model, the government makes an exogenous decision regarding the targeted debt level. The adjustment toward this targeted level is delineated through the fiscal rule and the selected fiscal instrument.

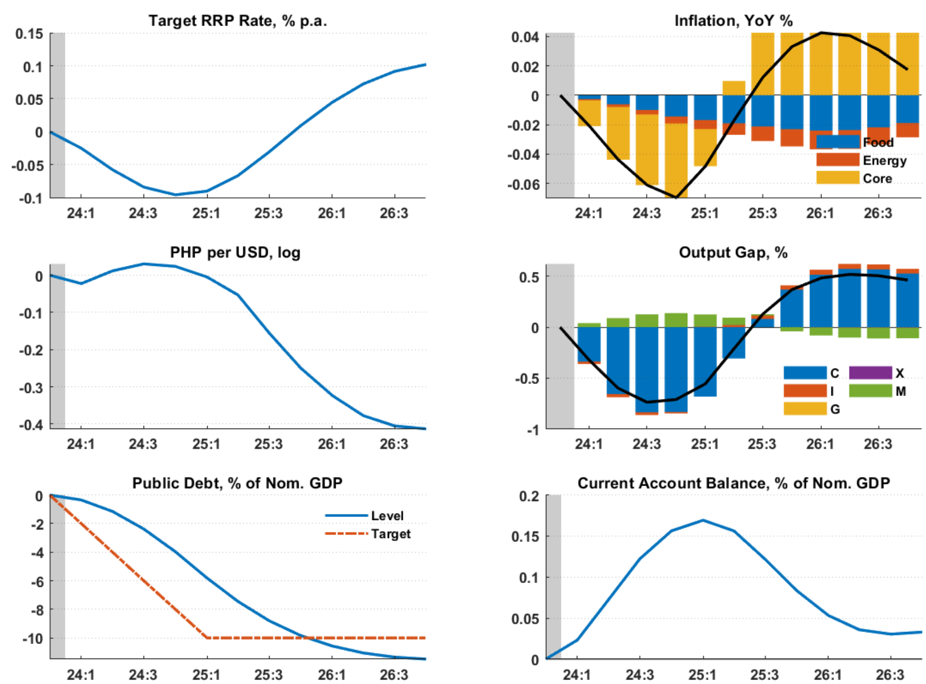
[38] The additional increase in consumption is modeled by shocking the residual term of the consumption gap equation.

This scenario, illustrated in Figure 4.4, depicts the impact of a more ambitious fiscal consolidation, aiming to gradually reduce the debt target by 10 percentage points of nominal GDP during 2024, reaching a lower debt level by the end of 2025.[39] In this scenario, the government implements measures such as raising taxes as well as enhancing revenue mobilization to generate additional revenues (particularly from the relatively low level of tax-to-GDP ratio) and achieve a surplus in the primary balance.

The debt reduction process is gradual, taking eight quarters to reach the new target, and aligns with the fiscal rule, allowing for gradual adjustments in the primary surplus (termed "cyclical smoothing") to prevent an overly restrictive fiscal stance and sharp economic slowdown. However, the reduction in household disposable income manifests in lower consumption levels and a contraction in the output gap. Subsequently, as the fiscal balance approaches neutrality and monetary policy maintains accommodative conditions, the output gap temporarily turns positive, accompanied by heightened inflation. The central bank responds by raising policy rates to guide inflation back to the target.

Furthermore, the debt consolidation strategy proportionally reduces the government's foreign liabilities, enhancing the external financing position and diminishing risk premiums. This process generates appreciation pressures on the peso in the medium term.

Figure 4.4: Public Debt Consolidation



[39] In 2023, the public debt level stood at the threshold of 60 percent of GDP, significantly surpassing the pre-pandemic average of 40 percent of GDP.

4.1.5 Asset Price Increase and Credit Boom

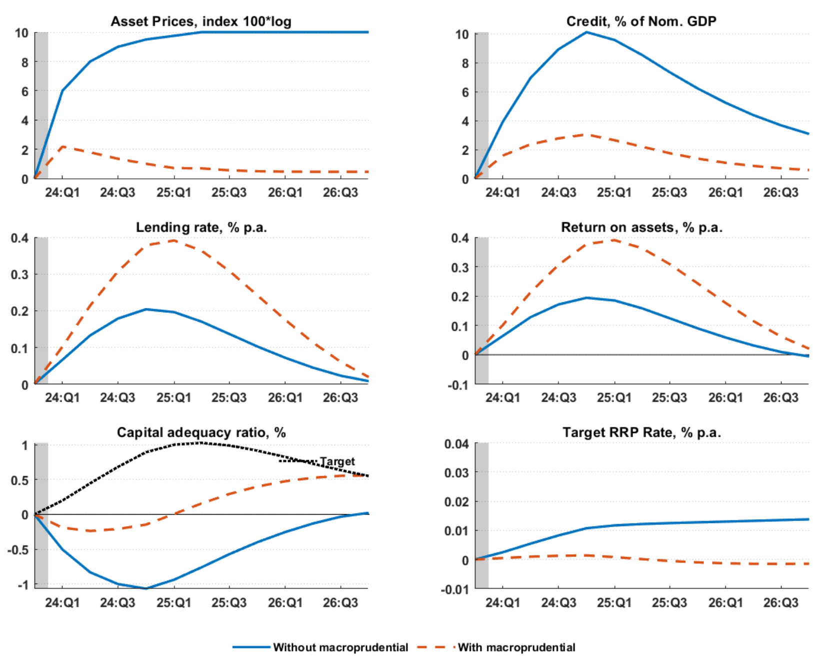
In Figure 4.5, asset prices experience a permanent 10 percent increase,[40] leading to a credit boom fueled by the higher value of collateral. With heightened credit activity, the balance sheet of commercial banks (measured by outstanding credit to nominal GDP) expands, while the capital adequacy ratio declines, increasing exposure to systemic risks and vulnerability to a potential asset price downturn.

Under the scenario of *'Without Macroprudential'* policy, the target for the capital adequacy ratio remains unchanged. However, commercial banks are required to meet capital requirements, necessitating the generation of additional capital. The simulation assumes that this additional capital is generated through profits derived from higher lending rate margins. Although the higher lending rate gradually curtails the credit boom, it takes two years to restore the capital adequacy ratio to the required level. Monetary policy responds to the shock only to the extent that it poses a threat to price stability.

In the second scenario of the shock, labeled *'With Macroprudential'*, macroprudential policy responds to the heightened systemic risk by increasing the target for the countercyclical capital buffer. Commercial banks are required to meet the elevated capital requirements by accumulating more capital, which is achieved by generating profits through increased lending rates (while reducing dividend payments). The tighter lending conditions effectively neutralize the impact of the asset price shock, maintaining pressure on long-term asset prices and mitigating the spillover effect on actual economic activity. Consequently, monetary policy tightening is deemed unnecessary.

The disparity between the two scenarios underscores the effectiveness of macroprudential policy in addressing asset price bubbles, whereas monetary policy tools such as interest rates are less precise in this regard.

Figure 4.5: Asset Price Increase and Credit Boom

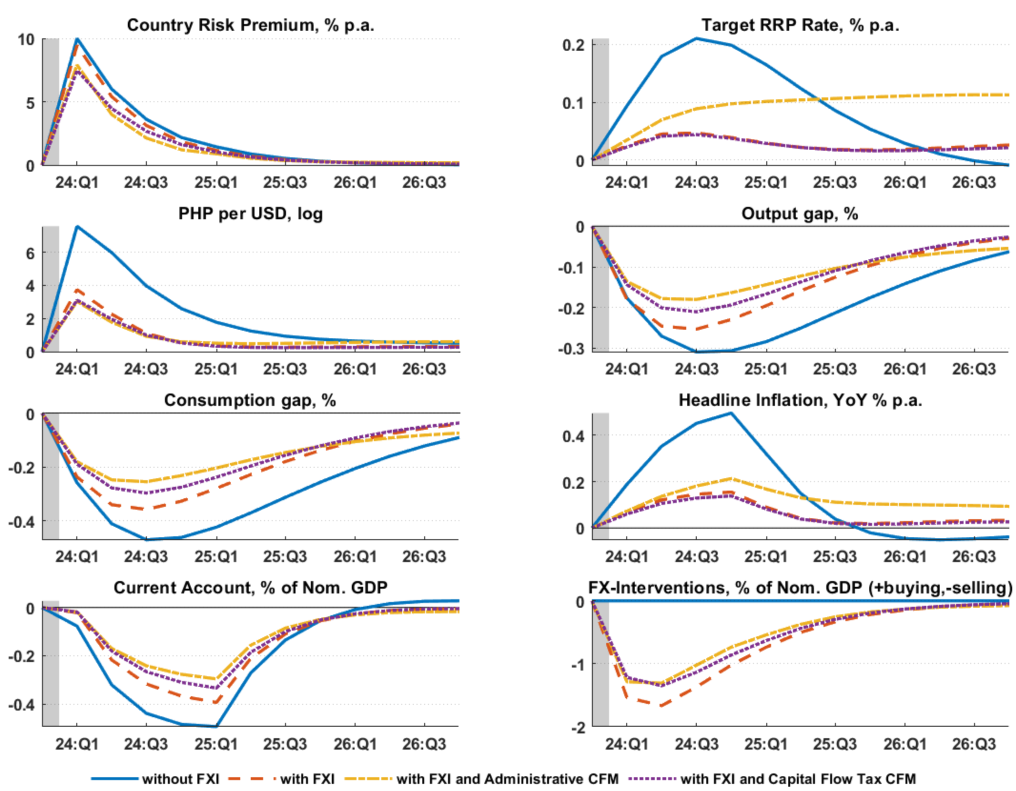


[40] We assume that asset prices are subjected to an exogenous shock (as described in eq.30), resulting in a 10 percent permanent deviation from the baseline level.

4.1.6 Risk Appetite Shocks

Figure 4.6 depicts the effects of a one-time negative 10 percentage point shock to risk appetite, generated by a shock to the country risk premium, resulting in an 8 percent nominal exchange rate depreciation in the initial scenario without FXI. In response to the resultant imported inflationary pressure, BSP reacts by tightening monetary conditions through an increase in the policy rate, leading to a contraction in real economic activity. Alternatively, the central bank may choose to sell FX reserves to alleviate immediate pressure on the exchange rate.[41] By doing so, the BSP could reduce the need for a substantial increase in the interest rate, thereby achieving price stability with a lower economic sacrifice. Moreover, if authorities impose CFMs on cross-border transactions to limit domestic agents' access to foreign financial markets, the economy becomes more insulated from the adverse effects of an increase in the risk premium. In the short run, both CFMs effectively complement FX intervention, requiring lower FX intervention to achieve the same nominal exchange rate depreciation. However, in the medium term, due to administrative CFMs, the pressure on prices cannot be fully offset by economic contraction, leading to a more depreciated nominal exchange rate.

Figure 4.6: Shock to Country Risk Premium



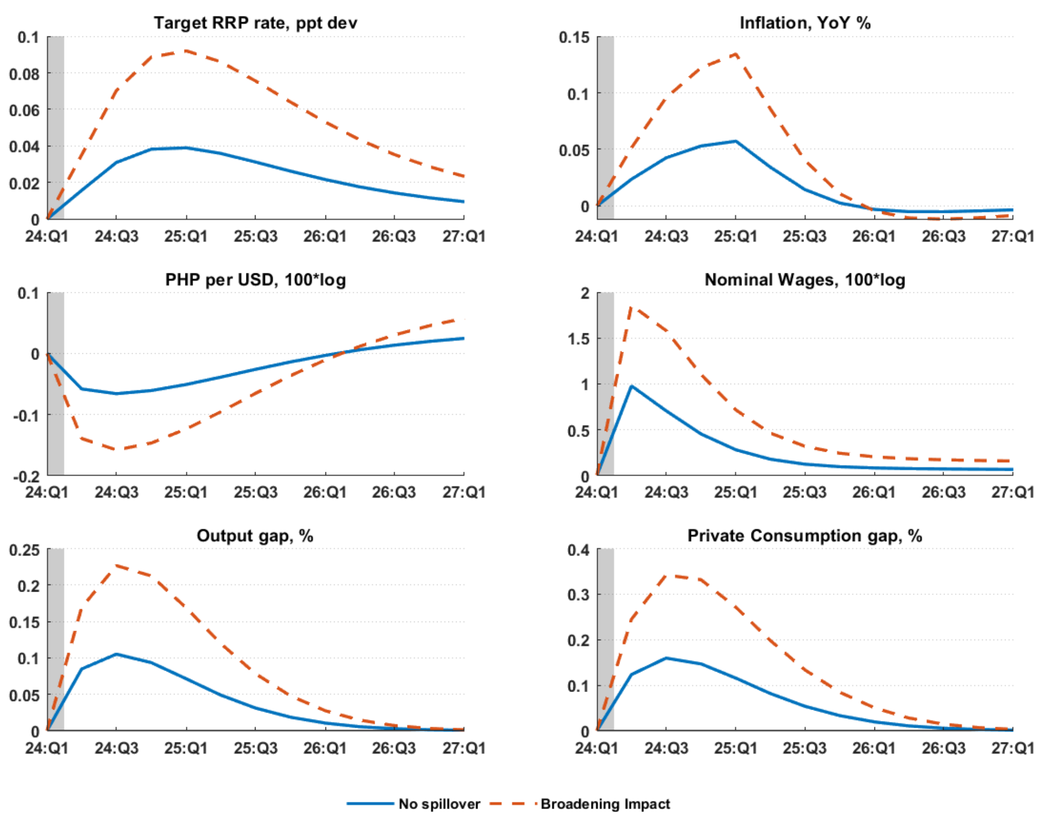
[41] The simulation involving FXI assumes that the central bank responds to disorderly market conditions and the rise in the risk premium (IMF 2023a). Under this intervention policy, once the shock dissipates, BSP initiates the replenishment of FX reserves to restore them to an adequate level.

4.1.7 Minimum Wage Increase Shocks

The simulation in Figure 4.7 presents the impact of a minimum wage increase on the economy. The shock to the minimum wage is equivalent to a year-on-year increase of about 4 percent, consistent with historical average minimum wage increase, implemented in Q4 2024. The simulation shows two scenarios: 1) no pass-through of minimum wage increase to the rest of the labor sector (orange line); and 2) partial pass-through of the minimum wage increase to business wages (blue line). In both scenarios, the additional wage hike boosts domestic demand through increased private consumption, leading to inflationary pressures. Higher wages likewise increase the marginal cost of firms that could result in additional price pressures, if passed on to consumers. The estimated impact is higher in the second scenario as it covers wage adjustments for the entire labor sector, as supposed to scenario 1 that assumes that only those receiving minimum wages will have additional income. Monetary policy responds by gradually tightening monetary conditions to bring inflation back to the targeted level.

Regarding its inflationary effects, the simulation aligns broadly with the Philippines version of the QIPF DSGE-model (IMF 2023c) in terms of magnitudes and signs of variable impulse responses. In standard DSGE-models, the consumption and GDP effects are typically close to neutral or negative because firms decrease labor demand, leaving household disposable income unchanged. Moreover, the reaction of monetary policy encourages intertemporal households to defer actual consumption decisions to stabilize inflation.

Figure 4.7: Shock to Minimum wage



4.2 Calibration and Empirical Validation of the Model[42]

4.2.1 Calibration: Parameter Categorization and Iterative Process

The calibration process ensures that the model produces accurate and reliable results, including a good fit with historical data, accurate forecasting, economic coherence, the ability to explain historical events, and consistency of parameter values with econometric estimates. We establish clear criteria for assessing the calibration and define the consecutive stages of the calibration process as follows (Berg et al., 2023): (i) defining the structure of PAMPh2.0; (ii) collecting and analyzing data; (iii) determining the parameters to be calibrated; and (iv) iteratively modifying parameter values to meet the specified criteria.

Throughout the calibration process, model-based assessments and forecasts must align with economic intuition and common institutional wisdom. This includes accurately estimating trends, cyclical components, and economic shocks.

In developing the PAMPh2.0 structure, a systematic approach is adopted, defining several steps and following a strategy in which each extension was gradually integrated into PAMPh's initial version, requiring periodic review of calibration as the model evolved. The process unfolded as follows: initially, the GDP expenditure side decomposition was introduced as the first extension; subsequently, the model was enriched with a fiscal block; this was followed by the incorporation of an external balance block, endogenous country risk premia, FX intervention, and CFM policies; finally, the credit channel with macroprudential policies and the labor block were integrated.

At each stage, gradually introduced extended versions underwent rigorous testing using Philippine data and were subjected to discussions among staff members, including sector and data experts from other departments in the BSP. The pace of model development was also mindful of absorption capacity, as a richer model necessitates a more thorough and in-depth analysis of the economy and increased horizontal communication within the central bank.

Categorization of coefficients and parameters

Highlighting their distinct nature and methods of parametrization, coefficients and parameters are classified in three groups:

a. *Parameters Determining the Steady-State*: These parameters reflect medium- and long-term historical averages of the data, such as potential growth, nominal ratios in terms of GDP, or import shares from Input-Output tables. They are consistent with medium-term policy objectives, such as inflation targets, reserve requirement ratios, or government debt targets, and are based on actual assessments or future expectations, such as assumptions about foreign variables like the medium-term position of the Fed interest rate and explicit or implicit inflation targets of trading partners.

[42] For a critical description of the calibration process see Maehle et al. (2021), and Berg et al. (2023) Box 5.

b. *Parameters Determining the Decomposition Between Gaps and Trends*: This group includes parameters and standard deviations crucial for the model's filtration and determining the gap-trend decomposition of variables. Typically, cycles are assumed to be more volatile than trends, reflected in a lower standard deviation for trends compared to cycles. Empirically, trends are more persistent than cycles, leading to higher autoregressive coefficients.[43] For cyclical variables, careful selection of relative sizes for standard deviations and autoregressive coefficients is necessary. For instance, investment volatility may exceed consumption and output gap volatility, necessitating corresponding adjustments in the estimation of unobserved variables.

c. *Parameters Governing Transmission Mechanisms and Policy Responses*: These coefficients, in PAMPh2.0, describe the structural linkages among variables, such as the strength of the interest rate channel, the size of fiscal multipliers, or the responsiveness of monetary policy to inflationary pressures. The process of model development carefully considers the values of these parameters to accurately capture the transmission mechanisms and policy responses.

<u>Calibration as distinct from estimation</u>

The parameterization of semi-structural models involves a systematic process distinct from a standard Bayesian estimation.[44] Calibration exercises typically follow a three-step iterative process outlined in MATLAB with the IRIS Toolbox.

i. Firstly, the model developer examines the dynamic properties of the model, such as impulse response functions for typical shocks. They then set parameter values based on institutional knowledge or policymakers' preferences. For instance, parameters related to the Taylor rule, governing the reaction to inflation, determine the speed of inflation normalization following a shock.

ii. In the second step, the model, integrated with a multivariate filter, estimates unobserved variables (e.g., output gap, gaps of GDP expenditure-side components, potential GDP, or natural interest rate) and structural shocks from observed time series.[45] This step allows for a reevaluation of the model's behavior and interpretation of observed data. It often prompts further discussions within the institution to refine aspects like the cyclical position of GDP or the neutral interest rate level, crucial for projections.

iii. Finally, the model generates in-sample forecasts for historically observed variables, validating whether the calibrated parameters effectively fit the data and project main tendencies and turning points in history. This procedure implicitly maximizes the model's likelihood, akin to Bayesian estimation, yielding parameter sets that provide a suitable fit.

The primary advantage of this calibration approach lies in incorporating expert views. It allows model developers and policymakers to control coefficient values, ensuring proper interpretation of actual data.

[43] The COVID-19 shock was interpreted as a negative level shift, temporarily increasing the volatility of the GDP trend. However, after 2020, the estimated trends have returned to the pre-pandemic smoothed dynamic.

[44] The Bayesian estimation is adept at efficiently estimating structural coefficients using observed time series data and prior assumptions, maximizing the historical likelihood of the model (i.e., the fit to the data given the model's structural characteristics). However, a key challenge of this method lies in setting prior distribution assumptions. The choice and configuration of the prior distribution function significantly influence the estimation outcome.

[45] In the following subsection, we detail the most recent estimation of the model and discuss its implications.

Calibration enables the integration of expert judgments and facilitates flexible treatment of incoming noisy (and short) data compared to estimation methods.

The calibration of PAMPh2.0 reflects the volatile nature of Philippine data. The relatively low values (mostly lower than 0.5) for backward-looking coefficients suggest a low persistence of inflation and real economic data. Consequently, macroeconomic variables are more susceptible to short-lived price shocks and commodity price shocks.[46] Additionally, the high volatility leads to relatively low values for elasticities, such as the interest rate elasticity in consumption gap or the output impact on core inflation compared to DSGE models. Conversely, the income channel exhibits greater strength, reflecting the relatively higher share of low-income and Keynesian households in the Philippines. The calibrated coefficients in the Taylor rule align closely with values found in the literature,[47] with a value of 1.5 for inflation deviation reaction, while the output gap reaction is 0.3. However, the interest rate smoothing is higher than benchmark values, indicating past behavior of the BSP to gradually change monetary policy settings.

Next subsections present in-sample simulations and the historical interpretation of the data as mentioned in calibration steps (ii) and (iii) above. Moreover, ex-post comparison of model based real-time forecasts with the actual data should be conducted to assess the model forecasting properties in real time exercise facing uncertainty and data revisions. However, this ex-post evaluation of the historical forecast evaluation can be conducted in the future when at least a year's worth of PAMPh2.0-based historical quarterly forecasts are collected and more elaborate databases are developed.

4.2.2 Empirical Validation: In-Sample Simulations

It is essential to note that similar parameter values for policy reactions do not imply that the BSP follows the same strategy as other central banks used for benchmarking. While the BSP may align with the global monetary policy cycle driven by the Fed, its response can differ due to various transmission channels and unique country characteristics. The BSP retains autonomy to react differently to country-specific or foreign-originated shocks. For instance, imported inflation pressure from exchange rates and commodity price pass-through holds greater significance for the Philippines compared to the U.S. Given the substantial weight of food and energy prices, headline inflation in the Philippines is notably volatile. The BSP operates with a forward-looking rule and typically refrains from reacting to one-off, temporary price shifts as these inflationary spikes often fade quickly with muted second-round effects. Additionally, the central bank aims to minimize real economic losses by maintaining the output gap around neutral levels.

As part of the empirical evaluation of the model, we conducted in-sample simulations[48] (refer to Figure 4.8), where we assumed that foreign variables are observed and checked the model's fit to domestic variables. Our findings indicate that the forecasted variables closely align with the observed data, capturing main turning points in the economy. Moreover, the model predictions exhibit minimal bias, with deviations from actual data remaining relatively small and changing sign over the forecast horizon, as reported in Table 4.1. However, it is important to consider the conditionality of in-sample forecasts on policy responses when assessing the

[46] In our estimation, we were unable to isolate the direct effects of CPI-related tax changes.

[47] The Reserve Board utilizes the Estimated Dynamic Optimization (EDO) model as a benchmark for forecasting and policy analysis. Inspired by the methodology outlined by Smets and Wouters (2007), the EDO model incorporates additional disaggregation of U.S. domestic spending, particularly in the housing and durable goods sectors. Moreover, the production block is structured to encompass two sectors, distinguishing between faster- and slower-growing industries (Chung et al., 2010).

[48] In-sample simulations are model-based and utilize data up to the beginning of each simulation, excluding external outlooks. In this way, these simulations replicate to a large extent forecasting methods used by central banks.

historical fit of the model. If the actual policy response differs from the policy conditions assumed in the forecast, the real model forecasts may diverge from actual data.

We can further assess the forecasting abilities of the PAMPh2.0 model by comparing the root mean squared errors (RMSE) with those of the random walk (RW) benchmark. A smaller RMSE ratio indicates that the PAMPh2.0 model provides superior forecasts, outperforming the RW benchmark for the respective variables and forecasting horizon.

Interestingly, for most variables and forecasting horizons, including volatile ones like inflation and GDP, the RMSE ratio is consistently better than the RW process, except for the current account deficit. Although the RMSE ratio for the current account deficit is higher, it remains very close to one, suggesting that while the RW process may offer a slightly better forecast, it cannot significantly outperform the PAMPh2.0 model. It is plausible that the current account has several unmodeled components outside the scope of the PAMPh2.0 model.

Figure 4.8: In-sample model simulations

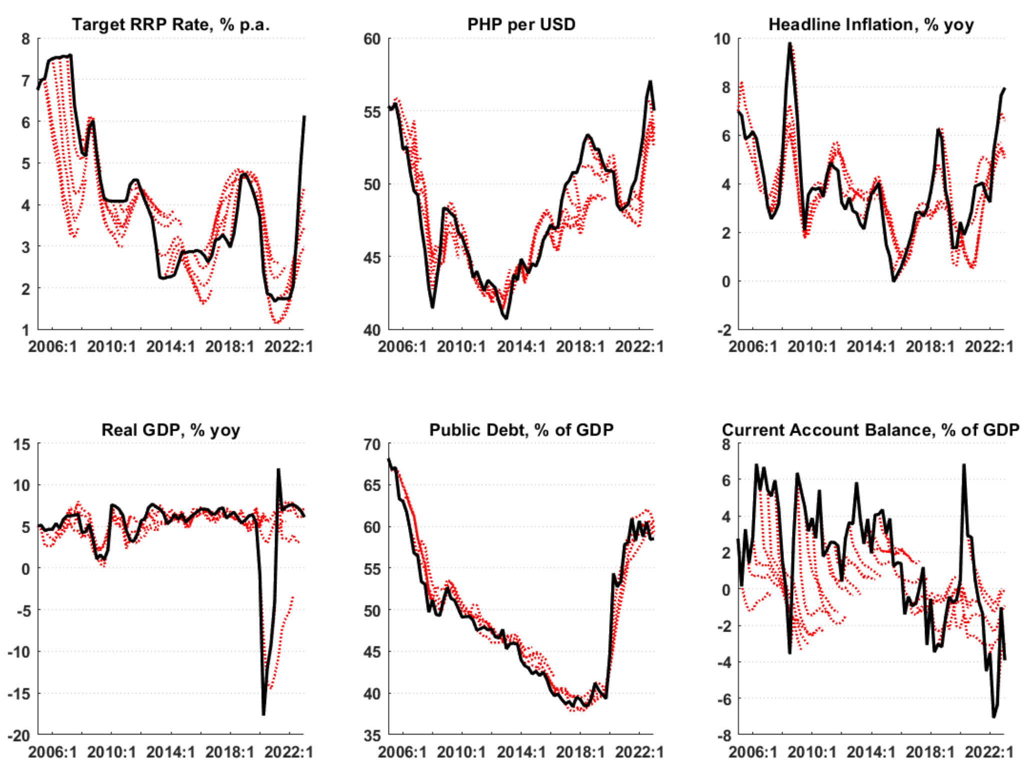


Table 4.1: Mean Errors and Root Mean Squared Errors relative to the Random Walk Process for selected variables

Mean Error

	1q	2q	3q	4q	5q	6q
Target RRP Rate (%)	-0.05	-0.13	-0.19	-0.23	-0.26	-0.26
PHP per USD	-0.29	-0.4	-0.43	-0.45	-0.46	-0.48
Headline CPI (YoY %)	-0.09	-0.19	-0.29	-0.38	-0.38	-0.35
Real GDP (YoY %)	-0.14	-0.18	-0.14	-0.05	0.22	0.38
Public Debt (% of GDP)	1.63	1.73	1.8	1.9	1.78	1.79
Current Account Balance (% of GDP)	-0.99	-1.13	-1.26	-1.33	-1.42	-1.48

RMSE Relative to Random Walk

	1q	2q	3q	4q	5q	6q
Target RRP Rate (%)	0.94	0.91	0.91	0.92	0.92	0.89
PHP per USD	0.83	0.70	0.66	0.61	0.59	0.56
Headline CPI (YoY %)	0.53	0.51	0.52	0.54	0.52	0.52
Real GDP (YoY %)	0.47	0.58	0.59	0.61	0.75	0.72
Public Debt (% of GDP)	0.87	0.69	0.53	0.43	0.38	0.33
Current Account Balance (% of GDP)	1.19	1.21	1.16	1.12	1.14	1.12

4.2.3 Empirical Validation: Historical Interpretation

As mentioned earlier, the evaluation of calibration and model performance can also be based on the historical interpretation of incoming data, including descriptions of estimated unobserved variables and structural shocks. These assessments collectively contribute to constructing a coherent economic narrative that elucidates underlying inflation pressures and shocks.

Using the Kalman filter, one can estimate unobserved variables (such as gaps and trends) and structural shocks based on observed time-series data. It is crucial to cross-check the gap and trend decomposition of key variables to ensure consistency with our interpretation of history—for example, understanding how the output gap contributes to high inflationary pressures. The filter also identifies structural shocks affecting the economy in each period. Additionally, we can test whether these shocks exhibit unbiased means and autocorrelations.[49]

The model provides several results that help readers understand the economic story behind the observations. Different cross-plots examine the co-movement of observed and unobserved variables. For instance, core inflation may be driven by real marginal cost, or commodity price shocks may have a prevalent role in inflation dynamics during certain periods. By analyzing structural equations, we can demonstrate how each determinant contributes to the outcome variable. This exercise ultimately tests the importance of specific variables or channels; for example, if core inflation is primarily driven by domestic demand (output gap), we expect its contribution to be visible and significant. Additionally, shock decompositions for selected variables describe how structural shocks explain historical fluctuations of model variables. For instance, inflation may be driven by a combination of demand, supply, and foreign-originated shocks over the years. By aligning our economic interpretation of observed time-series data with model outcomes, we can verify the accuracy of our interpretations.

These exercises help form the narrative around the model. However, there is no formal statistical test that decides which calibration is "better" or provides a more adequate description of the examined economy. The economic story, based on filtration outcomes, is discussed by blocks, with the primary focus set on unobserved variables.

4.2.3.1 Inflation

With three exceptions, Philippine inflation fluctuated in the upper band of the inflation target during the observation period (see Figure 4.9). While core inflation remained relatively stable and smooth, fluctuations in food and energy prices contributed to spikes in the index. Before the GFC, before the COVID-19 crisis, and due

[49] Only structural shocks are subject to zero means and no autocorrelation requirements. Shocks in non-structural equations, such as equations for trends, may naturally experience autocorrelated shocks by nature.

to the Russia-Ukraine war, commodity price shocks pushed headline inflation above the high-end of the target band.

Core inflation describes the underlying inflationary trend in the economy. In Figure 4.10, we illustrate how core inflation is influenced by the real marginal cost, which includes pressure from domestic demand, imported inflation, and the second-round effects of commodity price-driven domestic energy and food prices. As depicted in the figure, major trends in core inflation correspond to changes in real marginal cost. For instance, following the GFC, both real marginal cost and core inflation fluctuated below zero. Similarly, during recent inflationary pressures in 2022, a significant increase in real marginal cost was followed by a shift in core inflation.

Figure 4.9: Headline inflation and its breakdown, inflation % yoy and contributions in p.p.

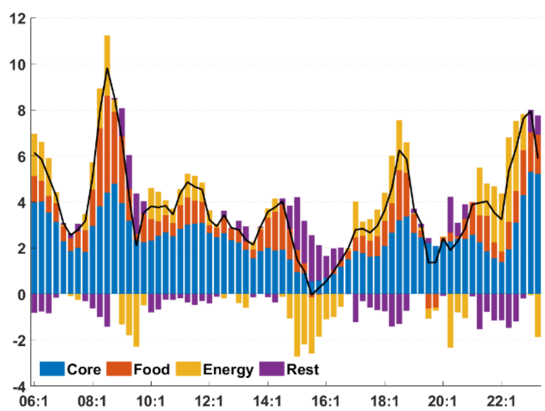
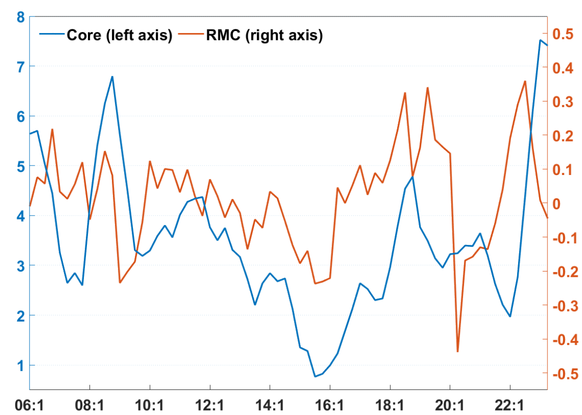
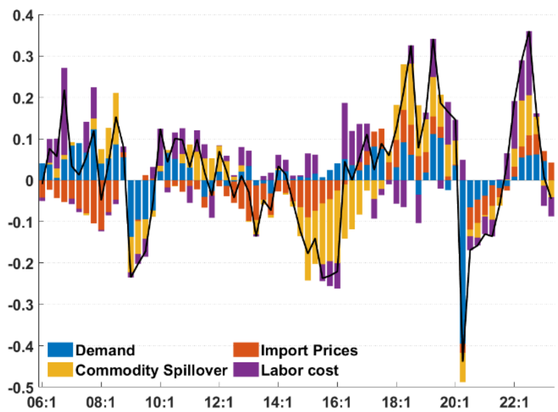
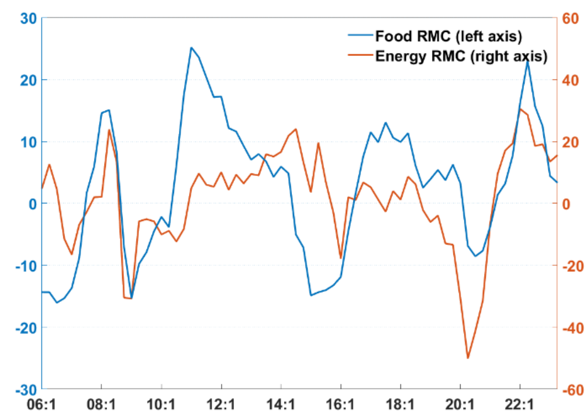


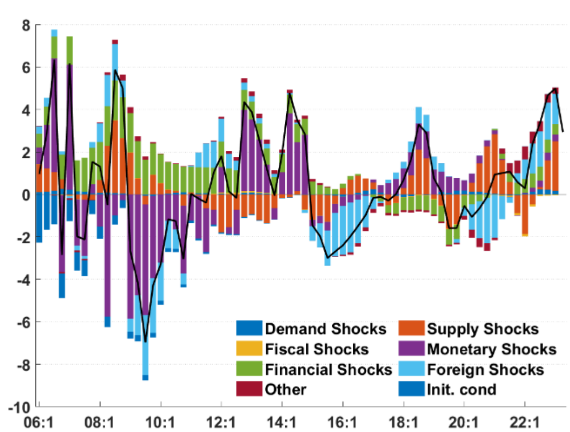
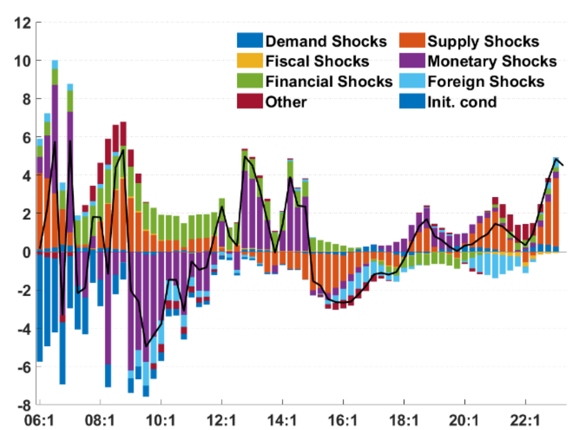
Figure 4.10: Core inflation (yoy %, left axis) and real marginal costs (% right axis)



Additionally, the model can elucidate the primary components influencing the real marginal cost function, as shown in Figures 4.11 and 4.12. The real marginal cost for core inflation is primarily influenced by fluctuations in the output gap and the spillover effects from non-core inflation. Except pre- and post-COVID-19 periods, import prices (a weighted average of trading partners' inflation in USD) have either negatively impacted the marginal cost or remained neutral. In contrast, the real marginal costs for non-core inflation exhibit much higher volatility, reflecting the fluctuations in international commodity prices and the nominal exchange rate. Each spike in the estimated cost function corresponds to periods of elevated inflation, serving as a reliable predictor for non-core inflationary pressure.

Figure 4.11: Decomposition of real marginal costs for core inflation, %	Figures 4.12: Real marginal costs for non-core inflations, %
	

One can also illustrate how the estimated historical shocks contribute to the endogenous variables of the model. Figures 4.13 and 4.14 depict the historical shock decomposition of headline inflation and core inflation, both plotted as deviations from their targets.[50] This decomposition effectively highlights that model variables are influenced by various shocks, each contributing to different aspects of inflation dynamics. Given the Philippines' status as an open economy with an open capital account and a freely floating exchange rate, foreign-originated shocks and financial shocks (such as exchange rate depreciation) play significant roles in both headline and core inflation, particularly evident before the GFC, in 2012, and during the post-COVID-19 recovery period. While supply shocks, including domestic-originated price shocks (primarily core or non-core cost-push shocks), also contribute to inflation dynamics, their influence is not as predominant. The impact of demand and fiscal shocks on core inflation is relatively limited, but their direction corresponds to periods of economic overheating before the GFC or economic slowdown during and after COVID-19.

Figure 4.13: Decomposition to shocks – Headline inflation deviation from the target, YoY %	Figure 4.14: Decomposition to shocks – Core inflation deviation from the implicit target, YoY %
	

50 In the case of core inflation, we calculate its target based on the headline target and changes in the relative price trend of core inflation.

4.2.3.2 Real Economic Activity

Besides the periods of the GFC and COVID-19, the Philippines' GDP growth rate fluctuated around 6 percent, with the model estimating stable and high potential growth (see Figure 4.15). During the COVID-19 crisis, growth markedly slowed down, and the estimation reflects the specific nature of this period, with potential growth also decreasing in 2020. However, the economy has since recovered and continued its robust growth.

Figure 4.16 describes the output gap and its breakdown. The output gap is a key determinant of inflationary pressures and significantly affects inflation forecasts, indirectly influencing policymakers' decision-making. Before the GFC, the output gap was positive, following a relatively neutral period. From 2016 until 2020, the output gap and inflationary pressures gradually intensified due to permanently loose global and domestic monetary conditions. The breakdown explains how each expenditure-side component has contributed to the fluctuations: household consumption and net exports play a major role in defining the underlying dynamics, while investment and government consumption gaps exhibit high volatility and generate temporary shifts in the output gap.

Figure 4.15: GDP and Potential Growth, YoY %

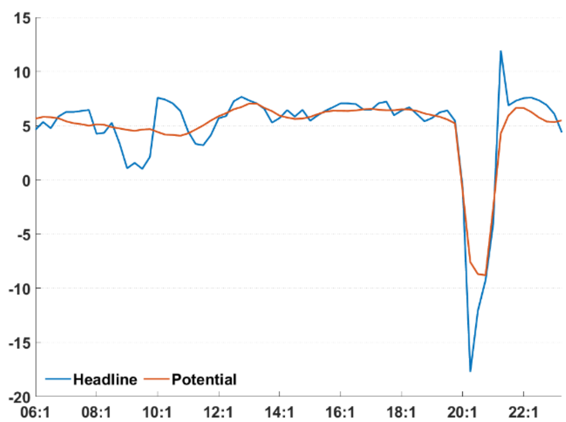
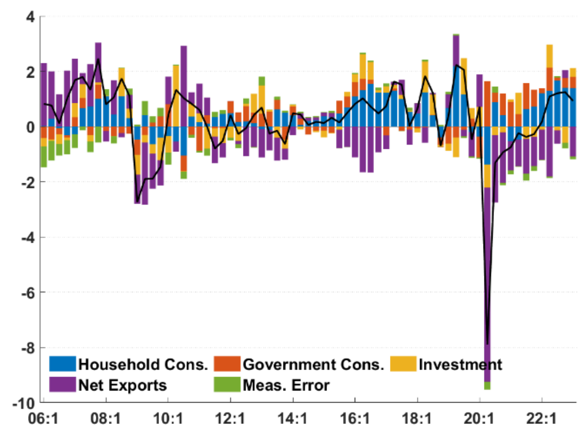


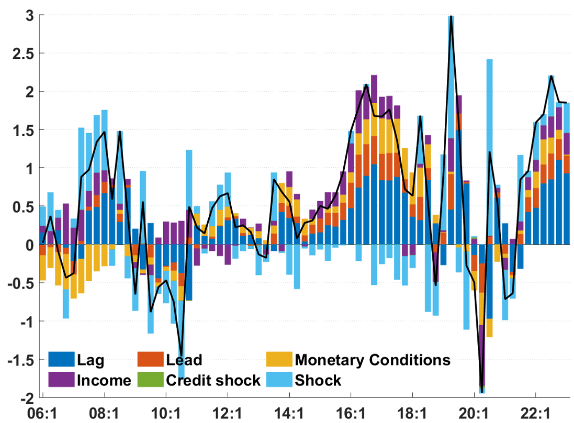
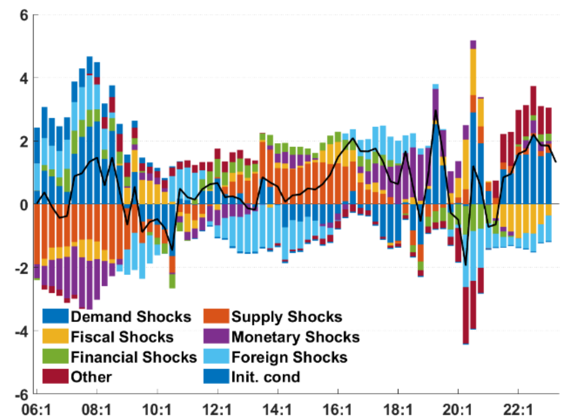
Figure 4.16: Output gap breakdown, pp



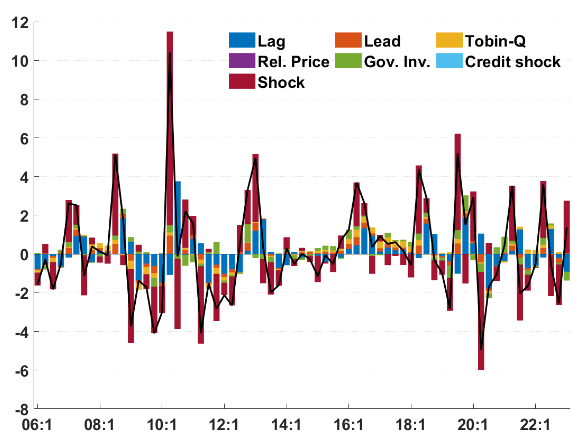
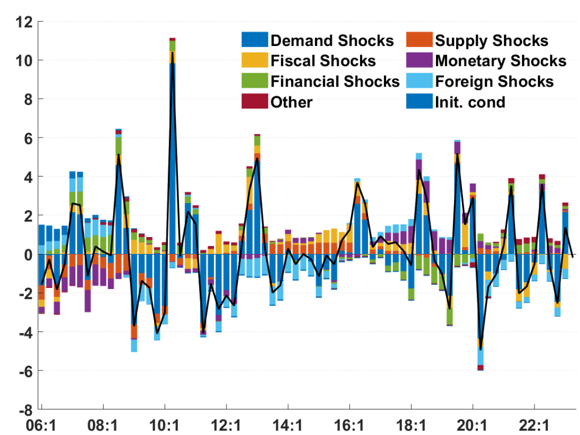
The consumption gap captures the domestic demand-related inflationary pressures, with its relatively large weight in the GDP, and it also determines a significant part of the output gap fluctuations. Figure 4.17 illustrates how the components of the consumption gap function determine the variables, while Figure 4.18 describes the historical shocks' contribution to the cyclical variables.

Before the GFC period, consumption exceeded its potential level, generating inflationary pressures. It was mostly driven by a favorable income position, including improving net exports and loose foreign monetary conditions. Following the financial crisis, consumption was relatively stable and fluctuated around the neutral zero level. However, similarly to the output gap, the gap started to increase due to loose monetary conditions and an improving income position. During the COVID-19 crisis, all components, besides the shock, in eq.[x] contributed negatively to the gap. However, the model illustrates that after 2022, the loose monetary policy and recovery in economic performance increased the consumption gap back to positive values, explaining the inflationary pressure in 2023.

The shock decomposition describes a consistent story: the fluctuations were mostly explained by foreign, financial, and monetary policy shocks. However, the shock decomposition also highlights how many different shocks determined the consumption gap, with most of them offsetting each other.

Figure 4.17: Decomposition of Consumption gap, %	Figure 4.18: Decomposition to shocks – Consumption gap, %
	

Investment and its gap are highly volatile variables, with a significant portion of the cyclical changes explained by their own shock (see Figures 4.19 and 4.20). Consequently, the contribution of the portfolio channel or relative prices is limited, and even the timing of government capital expenditures does not correspond with increases in the investment gap.

Figure 4.19: Decomposition of Investment gap, %	Figure 4.20: Decomposition to shocks – Investment gap, %
	

The export gap is also a highly volatile variable primarily determined by foreign shocks or, in the equation decomposition, by the foreign demand components. Previously, we assumed that the Philippines' exports are mostly driven by the semiconductor industry, which tends to be resilient to fluctuations in market share (such as changes in the real exchange rate and relative prices).

Figure 4.21: Decomposition of Export gap, %

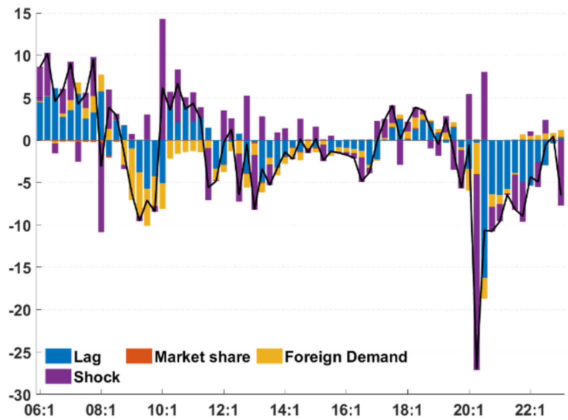
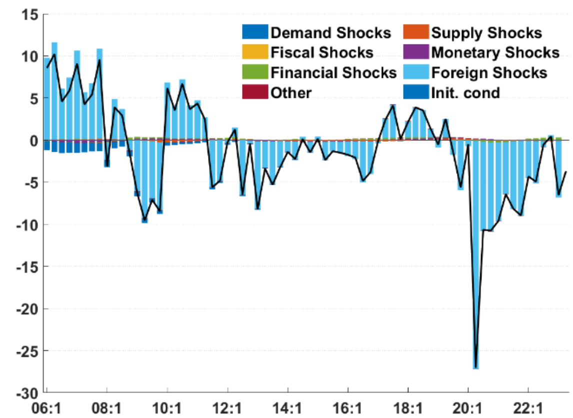


Figure 4.22: Decomposition to shocks – Export gap, %



The import gap is calculated as the sum of the weighted average of GDP demand-side components and its own shock. Given that the Philippine traded sector relies heavily on imports, the export gap plays a significant role in determining imports, while other components also contribute but to a lesser extent (see Figure 4.23). The shock decomposition in Figure 4.24 paints a similar picture: a large portion of the import gap is determined by foreign shocks (including export and import shocks), while other variables also influence imports through domestic demand components, albeit to a lesser degree.

Figure 4.23: Decomposition of Import gap, %

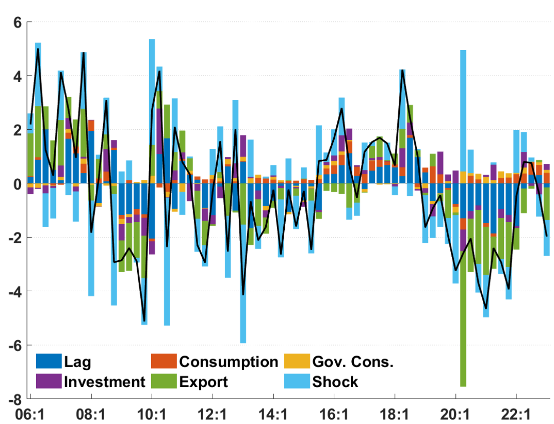
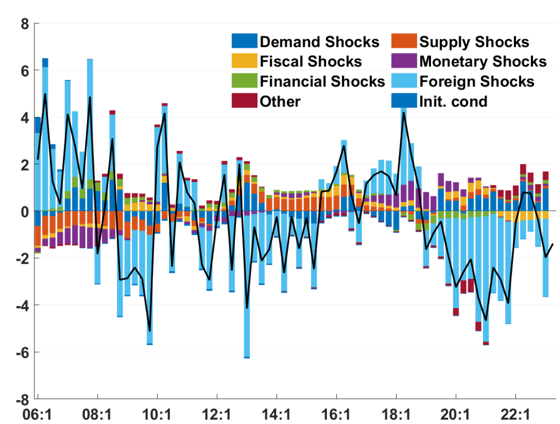


Figure 4.24: Decomposition to shocks – Import gap, %



4.2.3.3 Fiscal Policy

Before the COVID-19 crisis, the government pursued a successful debt consolidation strategy, reducing the national debt from 60 to 40 percent of nominal GDP (see Figure 4.25). However, during the COVID-19 crisis, the government financed increased expenditures by issuing more debt, causing public debt to rise to 60 percent of GDP.[51] Beginning in 2022, the fiscal authority opted to consolidate the debt level and reduce the total deficit. Figure 4.26 illustrates the components of the total deficit, which align with debt accumulation. The successful debt consolidation before the COVID-19 crisis coincided with decreasing debt service and a negative primary deficit (surplus). Additionally, favorable global monetary conditions post-GFC supported reduced debt service and the debt consolidation strategy. Conversely, following the COVID-19 crisis, the primary deficit significantly increased before gradually decreasing again from 2022.

Figure 4.25: Debt to GDP ratio, level and target decomposition, % of GDP

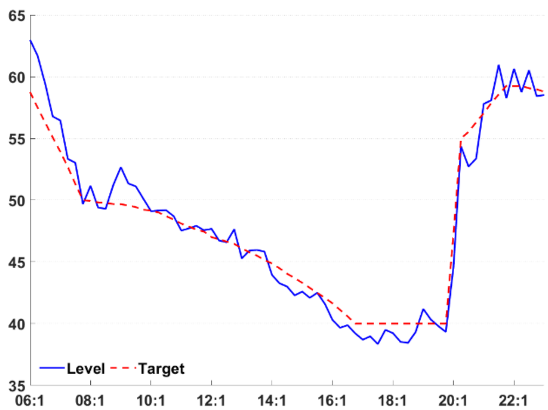
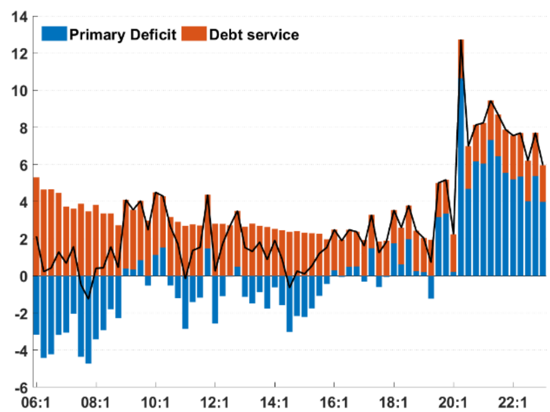
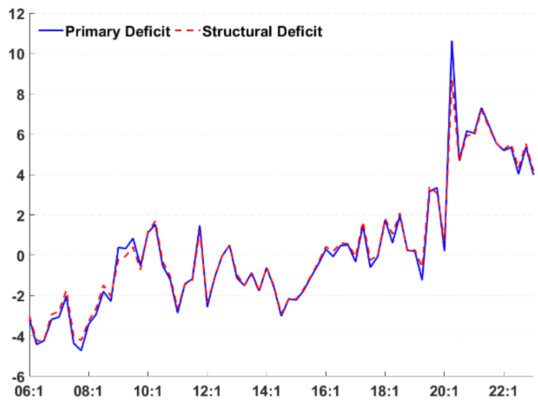
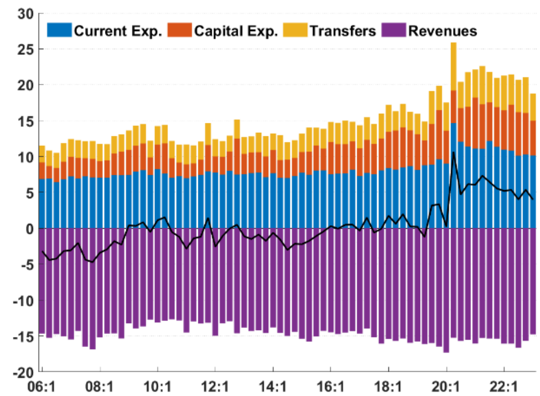


Figure 4.26: Government balance and its components, % of GDP



The structural deficit, representing the cyclically-adjusted primary deficit, reflects the fundamental stance of fiscal policy. As shown in Figure 4.27, the structural deficit closely tracked the primary deficit due to the relatively closed output gap. However, during the COVID-19 crisis, the disparity between these deficits widened, although by the end of the analyzed period, the structural deficit approached the primary deficit closely. The breakdown of the primary deficit (Figure 4.28) elucidates the dynamics of its main components. The government steadily augmented its revenue through improved revenue mobilization. Prior to the COVID-19 crisis, fiscal policy maintained relatively stable levels of current expenditure and transfer expenditures, while gradually boosting capital expenditures. In response to the COVID-19 crisis, the government escalated health-related and additional capital expenditures to mitigate the crisis' adverse effects. From 2022 onward, these supplementary measures began to be phased out gradually.

[51] Part of the increase in debt can be attributed to the significant drop in nominal GDP.

Figure 4.27: Primary Deficit and estimated Structural Deficit, % of GDP	Figure 4.28: Decomposition of primary deficit, % of GDP
	

4.2.3.4 Monetary Policy and Credit Channel

Assessing the stance of monetary policy requires an understanding of the medium-term dynamics of monetary conditions, such as the trend of the real interest rate or the natural real interest rate. In open economies, the trend of the real interest rate is influenced by factors including the foreign real interest rate trend, country risk premium trend, and the expected appreciation of the real exchange rate. Figure 4.29 illustrates the real effective exchange rate and its trend. Before the GFC, these trends followed the typical pattern observed in other emerging economies. During the period of the great moderation, strong capital inflows and expansion of the traded sector led to an appreciation of the real exchange rate. However, this trend slowed down after 2010, and the real exchange rate trend flattened, with short-term pressures on the peso evident. Between 2016 and 2019, nominal depreciation translated into real depreciation.

The estimated country risk premium derived from the UIP equation is closely linked to the external financing position and the current account deficit, as depicted in Figure 4.30. Following the GFC, there was a notable uptick in the country risk premium after a period of gradual decline. During the taper tantrum period (2016-2019), nominal depreciation of the peso was driven by capital outflows and an elevated country risk premium. After the recovery from the COVID-19 pandemic and amidst a new era of global monetary tightening, further pressure on external balances emerged, leading to an increase in the country's risk premium.

Figure 4.29: Real Effective Exchange rate and its trend, %

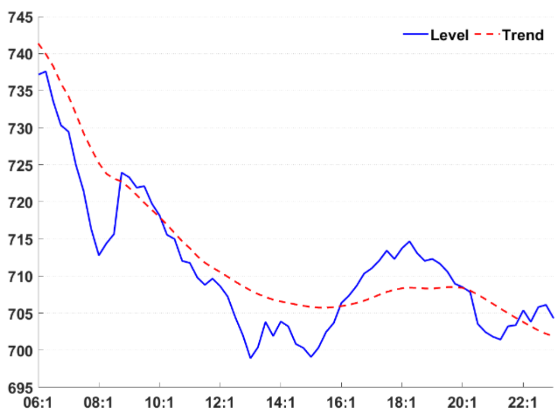
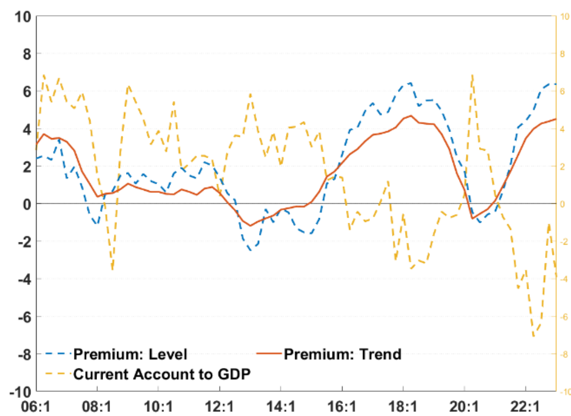


Figure 4.30: Current Account (% of GDP) and Estimated Country Risk Premium and its trend, %



The real interest rate and its deviation from the trend illustrate the relative tightness of monetary policy, as shown in Figure 4.31. When the level exceeds the trend (positive real interest rate gap), monetary policy is considered contractionary, negatively impacting the output gap. The decomposition below reveals that before the financial crisis, the central bank pursued a contractionary policy to stabilize inflation. Later, it shifted to a neutral and slightly expansionary stance in response to prolonged financial turmoil. However, from 2015 onward, it maintained an expansionary stance, with the real interest rate gap turning negative as it may not have responded sufficiently to increasing country risk premiums. The expansionary stance of policy is in line with intensifying inflationary pressures in this period. The onset of COVID-19 prompted a shift in monetary stance, with the BSP gradually reducing interest rates to support economic activity and counter the pandemic's adverse effects. After the recovery period in 2022, as inflationary pressures intensified, the central bank raised interest rates to align the real interest rate level with the trend and mitigate the positive output gap. The decomposition of the real interest rate trend indicates that its variability is primarily driven by the country risk premium and real exchange rate trend. These variations reflect the Philippines exposure to global financial market flows.

Figure 4.32 decomposes the nominal interest rate based on the Taylor rule, corroborating the narrative presented in the previous figure. The Taylor rule is calibrated to reflect historical monetary policy decisions aligned with the primary objective. The yellow bars correspond to periods when inflation exceeded the target, prompting BSP to increase the policy rate. Additionally, the figure illustrates instances of monetary policy deviations from the systematic rule: between 2016 and 2018 and in 2022, when relatively accommodative conditions were maintained, the model identifies negative monetary policy shocks.

Figure 4.31: Real Interest Rate and its trend with components, %

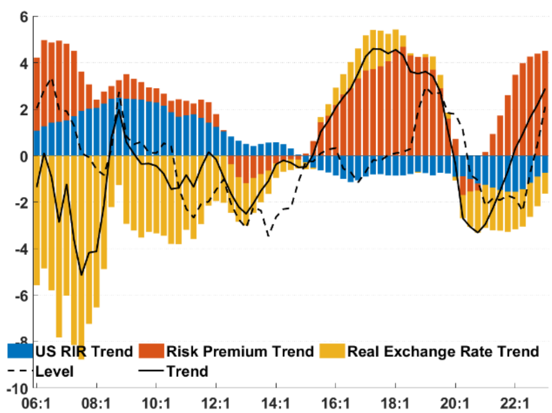
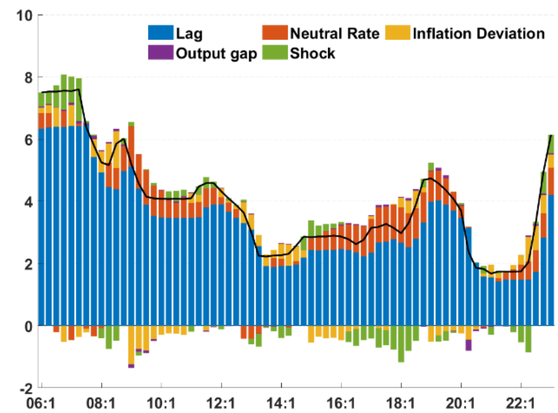


Figure 4.32: Decomposition of Monetary Policy Rate, %



Finally, the financial block of the model provides further insights into the development of the credit channel. Figure 4.33 illustrates the private sector credit stock as a percentage of nominal GDP. Following the GFC period, credit activity, particularly on the firms' side, became buoyant, supporting real economic growth. This significant credit expansion was facilitated by relatively accommodative monetary conditions and declining lending rates. Figure 4.34 shows that lending rates primarily decreased due to lower government bond rates (related to the monetary policy rate) and narrowing credit risk premiums. However, crisis periods such as the GFC and COVID-19 temporarily disrupted this trend, leading to increased credit risk premiums. Further, beginning in 2022, the credit growth markedly slowed down and began to decrease due to tightening monetary conditions and rising lending rates, reflecting the contractionary policy stance of the central bank.

Figure 4.33: Private Credit Stock, % of GDP

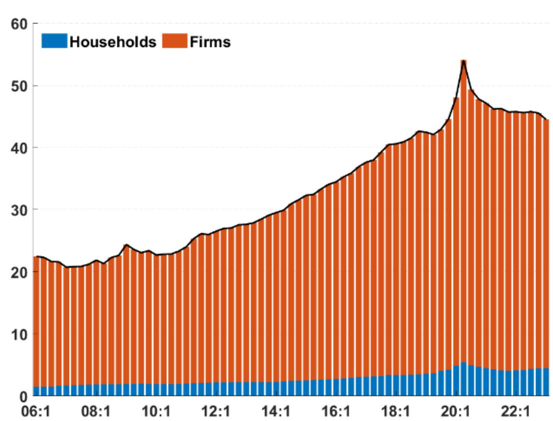
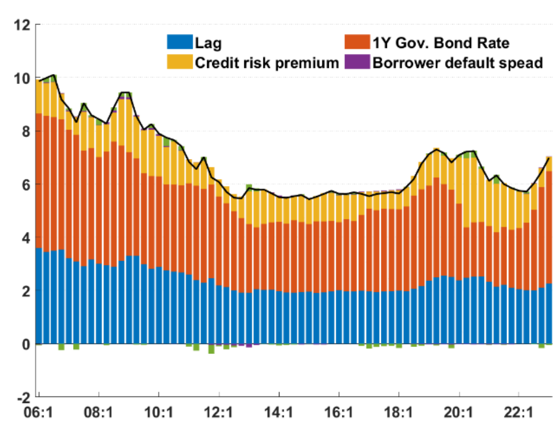


Figure 4.34: Decomposition of Lending Rate, %



5. Conclusion

The modernization initiative spearheaded by the BSP through the development of the Forecasting and Policy Analysis System (FPAS), featuring the semi-structural Quarterly Projection Model known as PAMPh2.0, represents a pivotal step towards equipping policymakers with a robust analytical tool for real-time decision-making amidst the intricacies of the macro-financial landscape. This endeavor, bolstered by the collaborative efforts with the IMF and guided by ICD-led technical assistance, signifies the BSP's commitment to leveraging advanced modeling techniques. Through iterative enhancements and extensions, PAMPh2.0 delivers forward-looking projections, incorporating endogenous monetary and fiscal policies, macrofinancial linkages, labor market dynamics, and additional tools such as FX intervention, fostering integrated thinking and coordination among various policy tools within the BSP.

The modernization drive extends beyond the core model to encompass essential reforms in pivotal elements of the FPAS, essential for effectively navigating the complexities of the multi-policy environment and facilitating informed policy deliberations. Moreover, a clear plan guiding activities towards the formal adoption of PAMPh2.0 underscores the BSP's unwavering commitment to model-based, data-driven decision-making.

Impulse response analysis has highlighted the structural interpretation of historical data within PAMPh2.0, enabling policy-contingent forecasts and risk assessments. By demonstrating the model's adaptability to a range of both fundamental and non-fundamental shocks, while accounting for the unique characteristics of the Philippines' macroeconomics and finance, it offers valuable insights into policy implications across different scenarios. This comprehensive understanding of the model's behavior supports informed policy decision-making. The recent application of the model to simulate the minimum wage increase scenario could effectively assist policymakers in understanding the various consequences of a wage hike, thereby enriching discussions about the risks to the inflation outlook.

The calibration process of the PAMPh2.0 model has ensured its accuracy and reliability by aligning with historical data, maintaining economic coherence, and leveraging institutional insights. This systematic approach involved incorporating various model extensions and undergoing rigorous testing and discussions among staff, allowing for the integration of expert views and flexibility in managing the volatile nature of Philippine data. Historical interpretation, supported by the Kalman filter, has played a pivotal role in constructing a coherent economic narrative, examining variable co-movement, and verifying the alignment of economic interpretations with model outcomes. The model enabled the policy advisor to reconcile and consistently explain the background of pre- and post-COVID-19 demand-side pressures, while also highlighting the contribution of the delayed monetary policy reaction to the intensifying inflationary pressure.

While no formal statistical test was conducted to determine the superiority of one calibration over another, these empirical exercises have been vital for constructing a coherent narrative around the model and validating its accuracy by aligning economic interpretations with model outcomes. In-sample simulations have offered empirical evidence of the model's performance, showing its effectiveness in capturing key turning points of domestic variables with minimal bias. For example, the model effectively captured the BSP tightening cycle before and after the COVID-19 periods, aligning consistently with the inflationary pressure. Notably, deviations from actual data are relatively small and tend to change signs over the forecast horizon, further enhancing confidence in the model's predictive capabilities.

In conclusion, the formal adoption of PAMPh2.0 not only provides staff and policymakers with a robust tool but also fosters the development and institutionalization of coordination among monetary, financial supervision, and macroprudential sectors within the BSP. This facilitates the assessment of business cycles and monetary policy stances, quantification of policy effects, understanding of trade-offs, and alignment with long-term objectives. In particular, the model has proven to be a valuable forecasting and policy analysis tool, especially in light of the recent surge in inflation. As PAMPh2.0 becomes the preferred core model for policy deliberation, its dynamic nature enables future refinements to align with evolving theoretical thinking and empirical findings.

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Appendix A: Model Variables

Real Aggregate Demand		
Code	**Name**	**Unit**
GDP		
Y	GDP: Real volume	level
y	GDP: Real volume	100*log
$\hat{y}$	GDP: Gap	% dev. from its trend
$\bar{y}$	GDP: Trend	100*log
Δy	GDP: Real volume	%, QoQ changes, annualized
$\Delta^4 y$	GDP: Real volume	%, YoY changes
$\Delta\bar{y}$	GDP: Trend	%, QoQ changes, annualized
$\Delta^4\bar{y}$	GDP: Trend	%, YoY changes
Private Consumption		
C	Private Consumption: Real volume	level
c	Private Consumption: Real volume	100*log
$\hat{c}$	Private Consumption: Gap	% dev. from its trend
$\bar{c}$	Private Consumption: Trend	100*log
Δc	Private Consumption: Real volume	%, QoQ changes, annualized
$\Delta^4 c$	Private Consumption: Real volume	%, YoY changes
$\Delta\bar{c}$	Private Consumption: Trend	%, QoQ changes, annualized
$\Delta^4\bar{c}$	Private Consumption: Trend	%, YoY changes
c^{rat}	Private Consumption: Nominal ratio	% of nominal GDP
$\bar{c}^{rat}$	Private Consumption: Nominal ratio trend	% of nominal GDP trend
Investment		
Inv	Total Investment: Real volume	level
inv	Total Investment: Real volume	100*log
$\widehat{inv}$	Total Investment: Gap	% dev. from its trend
$\hat{q}$	Tobin-Q	%
$\overline{inv}$	Total Investment: Trend	100*log
Δinv	Total Investment: Real volume	%, QoQ changes, annualized
$\Delta^4 inv$	Total Investment: Real volume	%, YoY changes
$\Delta\overline{inv}$	Total Investment: Trend	%, QoQ changes, annualized
$\Delta^4\overline{inv}$	Total Investment: Trend	%, YoY changes
inv^{rat}	Total Investment: Nominal ratio	% of nominal GDP
$\overline{inv}^{rat}$	Total Investment: Nominal ratio trend	% of nominal GDP trend

Government Consumption		
GC	Gov. Consumption: Real volume	level
gc	Gov. Consumption: Real volume	100*log
$\widehat{gc}$	Gov. Consumption: Gap	% dev. from its trend
$\overline{gc}$	Gov. Consumption: Trend	100*log
Δgc	Gov. Consumption: Real volume	%, QoQ changes, annualized
$\Delta^4 gc$	Gov. Consumption: Real volume	%, YoY changes
$\Delta\overline{gc}$	Gov. Consumption: Trend	%, QoQ changes, annualized
$\Delta^4\overline{gc}$	Gov. Consumption: Trend	%, YoY changes
gc^{rat}	Gov. Consumption: Nominal ratio	% of nominal GDP
$\overline{gc}^{rat}$	Gov. Consumption: Nominal ratio trend	% of nominal GDP trend
Export		
X	Export: Real volume	level
x	Export: Real volume	100*log
$\hat{x}$	Export: Gap	% dev. from its trend
$\bar{x}$	Export: Trend	100*log
Δx	Export: Real volume	%, QoQ changes, annualized
$\Delta^4 x$	Export: Real volume	%, YoY changes
$\Delta\bar{x}$	Export: Trend	%, QoQ changes, annualized
$\Delta^4\bar{x}$	Export: Trend	%, YoY changes
x^{rat}	Export: Nominal ratio	% of nominal GDP
$\bar{x}^{rat}$	Export: Nominal ratio trend	% of nominal GDP trend
Import		
M	Import: Real volume	level
m	Import: Real volume	100*log
$\hat{m}$	Import: Gap	% dev. from its trend
$\bar{m}$	Import: Trend	100*log
Δm	Import: Real volume	%, QoQ changes, annualized
$\Delta^4 m$	Import: Real volume	%, YoY changes
$\Delta\bar{m}$	Import: Trend	%, QoQ changes, annualized
$\Delta^4\bar{m}$	Import: Trend	%, YoY changes
m^{rat}	Import: Nominal ratio	% of nominal GDP
$\bar{m}^{rat}$	Import: Nominal ratio trend	% of nominal GDP trend

Labor market block		
Code	**Name**	**Unit**
Wage		
W^B	Nominal Business Wage	level
w^B	Nominal Business Wage	100*log
Δw^B	Nominal Business Wage	%, QoQ changes, annualized
$\Delta^4 w^B$	Nominal Business Wage	%, YoY changes
W^M	Nominal Minimum Wage	level
w^M	Nominal Minimum Wage	100*log
Δw^M	Nominal Minimum Wage	%, QoQ changes, annualized
$\Delta^4 w^M$	Nominal Minimum Wage	%, YoY changes
W	Nominal Average Wage	level
w	Nominal Average Wage	100*log
Δw	Nominal Average Wage	%, QoQ changes, annualized
$\Delta^4 w$	Nominal Average Wage	%, YoY changes
$\Delta \overline{w}$	Nominal Wage: Trend	%, QoQ changes, annualized
$\Delta^4 \overline{w}$	Nominal Wage: Trend	%, YoY changes
wr	Real Wage	100*log
$\widehat{wr}$	Real Wage: Gap	% dev. from its trend
$\overline{wr}$	Real Wage: Trend	100*log
$\Delta \overline{wr}$	Real Wage: Trend	%, QoQ changes, annualized
$\Delta^4 \overline{wr}$	Real Wage: Trend	%, YoY changes
Unemployment		
une	Private Consumption: Real volume	100*log
$\widehat{une}$	Private Consumption: Gap	% dev. from its trend
$\overline{une}$	Private Consumption: Trend	100*log

Banking sector and credit block		
Code	**Name**	**Unit**
	Wage	
cr^{rat}	Outstanding Credit	% of nominal GDP
$cr^{h,rat}$	Outstanding Credit: Households	% of nominal GDP
$ncr^{h,rat}$	Newly Issued Credit for Households	% of nominal GDP
$\widehat{ncr}^{h,rat}$	Newly Issued Credit for Households: Gap	% of nominal GDP
$\overline{ncr}^{h,rat}$	Newly Issued Credit for Households: Trend	% of nominal GDP trend
$cr^{f,rat}$	Outstanding Credit: Firms	% of nominal GDP
$ncr^{f,rat}$	Newly Issued Credit for Firms	% of nominal GDP
$\widehat{ncr}^{f,rat}$	Newly Issued Credit for Firms: Gap	% of nominal GDP
$\overline{ncr}^{f,rat}$	Newly Issued Credit for Firms: Trend	% of nominal GDP trend
rs^L	Nominal credit rate	%
r^L	Real credit rate	%
$\hat{r}^L$	Real credit rate: Gap	%
$\bar{r}^L$	Real credit rate: Trend	%
$\bar{r}^{L,HP}$	Real credit rate: HP-Trend	%
$prem^c$	Credit premium	%
$prem^{cc}$	Market risk premium of credit	%
$bspread$	Borrower default-risk	%
$\widehat{zh}$	Asset prices	%
bc^{ta}	Commercial Bank capital accumulation	% of nominal GDP
roa	Return on Assets	%
div^{ta}	Dividend of commercial banks	% of Total Assets
$bc^{ta,tar}$	Total Assets Target	% of nominal GDP trend
ta	Total assets of commercial banks	100*log
ta^{rat}	Total assets of commercial banks	% of nominal GDP trend
$cost^{adj}$	Credit costs	% of nominal GDP trend
Δta	Total assets of commercial banks	%, QoQ changes, annualized

Aggregate Supply		
Code	**Name**	**Unit**
CPI: Headline, Core, Non-Core and GDP deflator		
cpi	CPI: Headline index	100*log
Δcpi	CPI: Headline	%, QoQ changes, annualized
$\Delta^4 cpi$	CPI: Headline	%, YoY changes
cpi^{core}	CPI: Core index	100*log
Δcpi^{core}	CPI: Core	%, QoQ changes, annualized
$\Delta^4 cpi^{core}$	CPI: Core	%, YoY changes
rmc^{core}	Real marginal cost: Core	%
cpi^{food}	CPI: Non-Core, Food index	100*log
Δcpi^{food}	CPI: Non-Core, Food	%, QoQ changes, annualized
$\Delta^4 cpi^{food}$	CPI: Non-Core, Food	%, YoY changes
rmc^{food}	Real marginal cost: Non-Core, Food	%
cpi^{energy}	CPI: Non-Core, Energy index	100*log
Δcpi^{energy}	CPI: Non-Core, Energy	%, QoQ changes, annualized
$\Delta^4 cpi^{energy}$	CPI: Non-Core, Energy	%, YoY changes
rmc^{energy}	Real marginal cost: Non-Core, Energy	%
ϵ^{cpi}	CPI: Level Shock to the index	100*log
Relative prices		
rp^{core}	Relative price of Core: Index	100*log
$\widehat{rp}^{core}$	Relative price of Core: Gap	% dev. from its trend
$\overline{rp}^{core}$	Relative price of Core: Trend	100*log
$\Delta\overline{rp}^{core}$	Relative price of Core: Trend	%, QoQ changes, annualized
rp^{food}	Relative price of Food: Index	100*log
$\widehat{rp}^{food}$	Relative price of Food: Gap	% dev. from its trend
$\overline{rp}^{food}$	Relative price of Food: Trend	100*log
$\Delta\overline{rp}^{food}$	Relative price of Food: Trend	%, QoQ changes, annualized
rp^{energy}	Relative price of Energy: Index	100*log
$\widehat{rp}^{energy}$	Relative price of Energy: Gap	% dev. from its trend
$\overline{rp}^{energy}$	Relative price of Energy: Trend	100*log
$\Delta\overline{rp}^{energy}$	Relative price of Energy: Trend	%, QoQ changes, annualized

GDP Deflators		
Code	**Name**	**Unit**
Private Consumption		
p^C	Deflator: Private Consumption index	100*log
Δp^C	Deflator: Private Consumption	%, QoQ changes, annualized
$\Delta^4 p^C$	Deflator: Private Consumption	%, YoY changes
rp^C	Relative price of P.Cons. Deflator: Index	100*log
$\widehat{rp}^C$	Relative price of P.Cons. Deflator: Gap	% dev. from its trend
$\overline{rp}^C$	Relative price of P.Cons. Deflator: Trend	100*log
$\Delta\overline{rp}^C$	Relative price of P.Cons. Deflator: Trend	%, QoQ changes, annualized
Investment		
p^{Inv}	Deflator: Investment index	100*log
Δp^{Inv}	Deflator: Investment	%, QoQ changes, annualized
$\Delta^4 p^{Inv}$	Deflator: Investment	%, YoY changes
rmc^{Inv}	Real Marginal Cost: Investment deflator	100*log
rp^{Inv}	Relative price of Inv. Deflator: Index	100*log
$\widehat{rp}^{Inv}$	Relative price of Inv. Deflator: Gap	% dev. from its trend
$\overline{rp}^{Inv}$	Relative price of Inv. Deflator: Trend	100*log
$\Delta\overline{rp}^{Inv}$	Relative price of Inv. Deflator: Trend	%, QoQ changes, annualized
Government Consumption		
p^{Gc}	Deflator: Gov. Cons. index	100*log
Δp^{Gc}	Deflator: Gov. Cons.	%, QoQ changes, annualized
$\Delta^4 p^{Gc}$	Deflator: Gov. Cons.	%, YoY changes
rmc^{Gc}	Real Marginal Cost: Gov. Cons. deflator	100*log
rp^{Gc}	Relative price of Gov. Cons. Deflator: Index	100*log
$\widehat{rp}^{Gc}$	Relative price of Gov. Cons. Deflator: Gap	% dev. from its trend
$\overline{rp}^{Gc}$	Relative price of Gov. Cons. Deflator: Trend	100*log
$\Delta\overline{rp}^{Gc}$	Relative price of Gov. Cons. Deflator: Trend	%, QoQ changes, annualized

Export		
p^X	Deflator: Export index	100*log
Δp^X	Deflator: Export	%, QoQ changes, annualized
$\Delta^4 p^X$	Deflator: Export	%, YoY changes
rmc^X	Real Marginal Cost: Export deflator	100*log
rp^X	Relative price of Export Deflator: Index	100*log
$\widehat{rp}^X$	Relative price of Export Deflator: Gap	% dev. from its trend
$\overline{rp}^X$	Relative price of Export Deflator: Trend	100*log
$\Delta\overline{rp}^X$	Relative price of Export Deflator: Trend	%, QoQ changes, annualized
Import		
p^M	Deflator: Import index	100*log
Δp^M	Deflator: Import	%, QoQ changes, annualized
$\Delta^4 p^M$	Deflator: Import	%, YoY changes
rmc^M	Real Marginal Cost: Import deflator	100*log
rp^M	Relative price of Import Deflator: Index	100*log
$\widehat{rp}^M$	Relative price of Import Deflator: Gap	% dev. from its trend
$\overline{rp}^M$	Relative price of Import Deflator: Trend	100*log
$\Delta\overline{rp}^M$	Relative price of Import Deflator: Trend	%, QoQ changes, annualized
GDP		
p^{GDP}	Deflator: GDP index	100*log
Δp^{GDP}	Deflator: GDP	%, QoQ changes, annualized
$\Delta^4 p^{GDP}$	Deflator: GDP	%, YoY changes
rp^{GDP}	Relative price of GDP Deflator: Index	100*log
$\widehat{rp}^{GDP}$	Relative price of GDP Deflator: Gap	% dev. from its trend
$\overline{rp}^{GDP}$	Relative price of GDP Deflator: Trend	100*log
$\Delta\overline{rp}^{GDP}$	Relative price of GDP Deflator: Trend	%, QoQ changes, annualized
gdp^{nom}	Nominal GDP: index	100*log
Δgdp^{nom}	Nominal GDP	%, QoQ changes, annualized
$\Delta^4 gdp^{non}$	Nominal GDP	%, YoY changes
$\overline{gdp}^{nom}$	Nominal GDP: Trend	100*log
$\Delta\overline{gdp}^{nom}$	Nominal GDP: Trend	%, QoQ changes, annualized
$\Delta^4\overline{gdp}^{non}$	Nominal GDP: Trend	%, YoY changes

Monetary policy		
Code	**Name**	**Unit**
	Monetary policy	
re	Real exchange rate (with USD): Index	100*log
$\widehat{re}$	Real exchange rate (with USD): Gap	% dev. from its trend
$\overline{re}$	Real exchange rate (with USD): Trend	100*log
$\Delta\overline{re}$	Real exchange rate (with USD): Trend	%, QoQ changes, annualized
$reer$	Real eff. exchange rate: Index	100*log
$\widehat{reer}$	Real eff. exchange rate: Gap	% dev. from its trend
$\overline{reer}$	Real eff. exchange rate: Trend	100*log
$\Delta\overline{reer}$	Real eff. exchange rate: Trend	%, QoQ changes, annualized
Δcpi^{TAR}	Implicit Headline CPI target	%, QoQ changes, annualized
$\Delta cpi^{core,TAR}$	Implicit Core CPI target	%, QoQ changes, annualized
$\Delta cpi^{food,TAR}$	Implicit Non-Cor, Food CPI target	%, QoQ changes, annualized
$\Delta cpi^{energy,TAR}$	Implicit Non-Cor, Energy CPI target	%, QoQ changes, annualized
i^{pol}	BSP Target RRP Rate	%
i^{M}	Market Interest Rate	%
r	Real Interest Rate	%
$\hat{r}$	Real Interest Rate: Gap	%
$\bar{r}$	Real Interest Rate: Trend	%
s	Nominal exchange rate: Index (PHL/USD)	100*log
Δs	Nominal exchange rate	%, QoQ changes, annualized
$\Delta^4 s$	Nominal exchange rate	%, YoY changes
$\Delta\bar{s}$	Nominal exchange rate: Trend	%, QoQ changes, annualized
$\Delta^4\bar{s}$	Nominal exchange rate: Trend	%, YoY changes
$prem$	Country Risk Premium	%
$\widehat{prem}$	Country Risk Premium: Gap	%
$\overline{prem}$	Country Risk Premium: Trend	%
fxi^{rat}	FX-Interventions	% of nominal GDP
fxa^{rat}	FX-reserve accumulation	% of nominal GDP
$\overline{fxa}^{rat}$	FX-reserve accumulation: Trend	% of nominal GDP trend
$fxres^{rat}$	FX-reserve: Total	% of nominal GDP
$\overline{fxres}^{rat}$	FX-reserve: Trend	% of nominal GDP trend
$fxres^{ratimp}$	FX-reserve: Total	in months of import
$\overline{fxres}^{ratimp}$	FX-reserve: Trend	in months of import
$\widehat{fxres}^{ratimp}$	FX-reserve: Gap	in months of import
$\tau^{CFM,Admin}$	CFM: Administrative, tax rate	%
$\tau^{CFM,Flow}$	CFM: Price-based, tax rate	%

Balance of payment		
Code	**Name**	**Unit**
ca^{rat}	Current Account: Nominal ratio total	% of nominal GDP
$\overline{ca}^{rat}$	Current Account: Nominal ratio trend	% of nominal GDP trend
$\widehat{ca}^{rat}$	Current Account: Nominal ratio gap	% of nominal GDP
nx^{rat}	Net Export: Nominal ratio total	% of nominal GDP
$\overline{nx}^{rat}$	Net Export: Nominal ratio trend	% of nominal GDP trend
$\widehat{nx}^{rat}$	Net Export: Nominal ratio gap	% of nominal GDP
$remit^{rat}$	Remittances: Nominal ratio total	% of nominal GDP
$\overline{remit}^{rat}$	Remittances: Nominal ratio trend	% of nominal GDP trend
$\widehat{remit}^{rat}$	Remittances: Nominal ratio gap	% of nominal GDP
oth^{rat}	Other foreign income: Nominal ratio total	% of nominal GDP
$\overline{oth}^{rat}$	Other foreign income: Nominal ratio trend	% of nominal GDP trend
$\widehat{oth}^{rat}$	Other foreign income: Nominal ratio gap	% of nominal GDP
fa^{rat}	Financial Account: Nominal ratio total	% of nominal GDP
$\overline{fa}^{rat}$	Financial Account: Nominal ratio trend	% of nominal GDP trend
$\widehat{fa}^{rat}$	Financial Account: Nominal ratio gap	% of nominal GDP
nfp^{rat}	Private sector foreign financing: Nominal ratio total	% of nominal GDP
$\overline{nfp}^{rat}$	Private sector foreign financing: Nominal ratio trend	% of nominal GDP trend
$\widehat{nfp}^{rat}$	Private sector foreign financing: Nominal ratio gap	% of nominal GDP

Fiscal variables		
Code	**Name**	**Unit**
$intcost^{rat}$	Debt service: Total	% of nominal GDP
$intcost^{rat,TAR}$	Debt service: Total	% of nominal GDP trend
$intcost^{d,rat}$	Debt service: LCY	% of nominal GDP
$intcost^{d,rat,TAR}$	Debt service: LCY	% of nominal GDP trend
$intcost^{f,rat}$	Debt service: FCY	% of nominal GDP
$intcost^{f,rat,TAR}$	Debt service: FCY	% of nominal GDP trend
$i4^{d}$	1Y LCY Interest rate	%
$\overline{i4}^{d}$	1Y LCY Interest rate: Trend	%
$tprem^{d}$	1Y LCY Term premium	%
$i4^{*}$	1Y FCY Interest rate	%
$\overline{i4}^{*}$	1Y FCY Interest rate: Trend	%
$tprem^{f}$	1Y FCY Term premium	%
$debt^{rat}$	Public Debt: Total	% of nominal GDP
$debt^{rat,TAR}$	Public Debt: Total Target	% of nominal GDP trend
$debt^{d,rat}$	Public Debt: LCY	% of nominal GDP
$debt^{d,rat,TAR}$	Public Debt: LCY Target	% of nominal GDP trend
$debt^{f,rat}$	Public Debt: FCY	% of nominal GDP
$debt^{f,rat,TAR}$	Public Debt: FCY Target	% of nominal GDP trend
$debt1Y^{d,rat}$	Public Debt: LCY	% of nominal GDP
$debt1Y^{f,rat,TAR}$	Public Debt: LCY Target	% of nominal GDP trend
$debt1Y^{f,rat}$	Public Debt: FCY	% of nominal GDP
$debt1Y^{f,rat,TAR}$	Public Debt: FCY Target	% of nominal GDP trend
def^{rat}	Government Balance: Total	% of nominal GDP
$def^{rat,TAR}$	Government Balance: Target	% of nominal GDP trend

$primdef^{rat}$	Primary Deficit: Total	% of nominal GDP
$defstruct^{rat}$	Primary Deficit: Cyclically Adjusted	% of nominal GDP
$defcycle^{rat}$	Primary Deficit: Cyclically Part	% of nominal GDP
$\widehat{debt}^{rat}$	Debt deviation term	% of nominal GDP
θ	LCY Financing share	%/100
$defstruct^{rat,TAR}$	Primary Deficit: Target	% of nominal GDP trend
rev^{rat}	Total Revenue	% of nominal GDP
$\widehat{rev}^{rat}$	Total Revenue: Gap	% of nominal GDP
$\overline{rev}^{rat}$	Total Revenue: Trend	% of nominal GDP trend
ex^{rat}	Total Expenditures	% of nominal GDP
$\widehat{ex}^{rat}$	Total Expenditures: Gap	% of nominal GDP
$\overline{ex}^{rat}$	Total Expenditures: Trend	% of nominal GDP trend
g^{rat}	Current Expenditures	% of nominal GDP
$\hat{g}^{rat}$	Current Expenditures: Gap	% of nominal GDP
$\bar{g}^{rat}$	Current Expenditures: Trend	% of nominal GDP trend
gi^{rat}	Capital Expenditures	% of nominal GDP
$\widehat{gi}^{rat}$	Capital Expenditures: Gap	% of nominal GDP
$\overline{gi}^{rat}$	Capital Expenditures: Trend	% of nominal GDP trend
tr^{rat}	Transfers	% of nominal GDP
$\widehat{tr}^{rat}$	Transfers: Gap	% of nominal GDP
$\overline{tr}^{rat}$	Transfers: Trend	% of nominal GDP trend
of^{rat}	Other Expenditures	% of nominal GDP
$\widehat{of}^{rat}$	Other Expenditures: Gap	% of nominal GDP
$\overline{of}^{rat}$	Other Expenditures: Trend	% of nominal GDP trend

Foreign variables		
Code	**Name**	**Unit**
Relative prices: Commodities		
pc^{oil}	Oil price: Index, USD	100*log
rpc^{oil}	Relative price of oil: Index	100*log
$\widehat{rpc}^{oil}$	Relative price of oil: Gap	% dev. from its trend
$\overline{rpc}^{oil}$	Relative price of oil: Trend	100*log
$\Delta\overline{rpc}^{oil}$	Relative price of oil: Trend	%, QoQ changes, annualized
pc^{food}	Food price: Index, USD	100*log
rpc^{food}	Relative price of food: Index	100*log
$\widehat{rpc}^{food}$	Relative price of food: Gap	% dev. from its trend
$\overline{rpc}^{food}$	Relative price of food: Trend	100*log
$\Delta\overline{rpc}^{food}$	Relative price of food: Trend	%, QoQ changes, annualized
US and other trading partners		
i^{US}	US FED Interest rate	%
r^{US}	US Real Interest Rate	%
$\hat{r}^{US}$	US Real Interest Rate: Gap	%
$\bar{r}^{US}$	US Real Interest Rate: Trend	%
cpi^{*}	Effective Foreign Prices in USD	100*log
$\hat{y}^{w}$	Effective Foreign Demand	%
j={US,EZ,CN,JP,RC}		
cpi^{j}	CPI in Country j: Headline index	100*log
Δcpi^{j}	CPI in Country j: Headline	%, QoQ changes, annualized
$\Delta^{4} cpi^{j}$	CPI in Country j: Headline	%, YoY changes
$\hat{y}^{j}$	Output Gap in Country j	% of potential GDP
j={EZ,CN,JP,RC}		
s^{j}	Nominal Ex. Rate j vis-à-vis USD	100*log
Δs^{j}	Nominal Ex. Rate j vis-à-vis USD	%, QoQ changes, annualized
$\widehat{re}^{j}$	Real Ex. Rate j vis-à-vis USD	%
$\Delta\overline{re}^{j}$	Real Ex. Rate j vis-à-vis USD	%, QoQ changes, annualized

Shocks in the model		
Code	**Name**	**Unit**
$\varepsilon^{\hat{c}}$	Shock to Consumption Gap	%
$\varepsilon^{\Delta w^B}$	Shock to Nominal Business Wage	%
$\varepsilon^{\Delta w^M}$	Shock to Nominal Wage	%
$\varepsilon^{\Delta \overline{wr}}$	Shock to Real Wage Trend	%
$\varepsilon^{\widehat{une}}$	Shock to Unemployment Gap	%
$\varepsilon^{\overline{une}}$	Shock to Unemployment Trend	%
$\varepsilon^{\widehat{gc}}$	Shock to Gov. Consumption Gap	%
$\varepsilon^{\widehat{inv}}$	Shock to Investment Gap	%
$\varepsilon^{\hat{x}}$	Shock to Export Gap	%
$\varepsilon^{\widehat{m}}$	Shock to Export Gap	%
$\varepsilon^{\Delta \bar{y}}$	Shock to Potential Growth Rate	%
$\varepsilon^{\Delta \bar{c}}$	Shock to Consumption Trend	%
$\varepsilon^{\Delta \overline{gc}}$	Shock to Gov. Consumption Trend	%
$\varepsilon^{\Delta \overline{inv}}$	Shock to Investment Trend	%
$\varepsilon^{\Delta \bar{x}}$	Shock to Export Trend	%
$\varepsilon^{cr^{h,hat}}$	Shock to Households Outstanding Credit	%
$\varepsilon^{cr^{f,hat}}$	Shock to Firms Outstanding Credit	%
$\varepsilon^{\widehat{ncr}^{h,hat}}$	Shock to Households' New Credit gap	%
$\varepsilon^{\overline{ncr}^{h,hat}}$	Shock to Households' New Credit trend	%
$\varepsilon^{\widehat{ncr}^{f,hat}}$	Shock to Firms' New Credit gap	%
$\varepsilon^{\overline{ncr}^{f,hat}}$	Shock to Firms' New Credit trend	%
ε^{rs^L}	Shock to Credit Rates	%
$\varepsilon^{prem^{cc}}$	Shock to Market Risk Premium	%
$\varepsilon^{bspread}$	Shock to Default Risk Premium	%
ε^{ta}	Shock to Total Assets	%
$\varepsilon^{\widehat{zh}}$	Shock to Asset Prices	%
ε^{bc}	Shock to Bank Capital	%
ε^{roa}	Shock to Return on Asset ratio	%
ε^{div}	Shock to Dividend	%
$\varepsilon^{bc,ta,tar}$	Shock to Bank Capital Total Asset Ratio	%
$\varepsilon^{\Delta cpi}$	Shock to Headline CPI weights	%
$\varepsilon^{\Delta cpi^{core}}$	Shock to Core CPI	%
$\varepsilon^{\Delta cpi^{food}}$	Shock to Non-Core, Food CPI	%
$\varepsilon^{\Delta cpi^{energy}}$	Shock to Non-Core, Energy CPI	%
$\varepsilon^{\Delta \overline{rp}^{core}}$	Shock to Relative Core Price Trend	%
$\varepsilon^{\Delta \overline{rp}^{food}}$	Shock to Relative Food Price Trend	%
$\varepsilon^{\Delta p^c}$	Shock to Consumption Deflator	%
$\varepsilon^{\Delta \overline{rp}^c}$	Shock to Relative Cons. Deflator Trend	%
$\varepsilon^{\Delta p^{Gc}}$	Shock to Gov. Cons. Deflator	%
$\varepsilon^{\Delta \overline{rp}^{Gc}}$	Shock to Relative Gov. Cons. Deflator Trend	%
$\varepsilon^{\Delta p^{Inv}}$	Shock to Investment Deflator	%
$\varepsilon^{\Delta \overline{rp}^{Inv}}$	Shock to Relative Inv. Deflator Trend	%
$\varepsilon^{\Delta p^X}$	Shock to Export Deflator	%

Shocks in the model		
Code	**Name**	**Unit**
$\varepsilon^{\Delta\overline{rp}^X}$	Shock to Relative Export Deflator Trend	%
$\varepsilon^{\Delta p^M}$	Shock to Import Deflator	%
$\varepsilon^{\Delta\overline{rp}^M}$	Shock to Relative Import Deflator Trend	%
$\varepsilon^{\Delta\widehat{rp}^{GDP}}$	Shock to GDP Deflator	%
$\varepsilon^{\Delta\overline{rp}^{GDP}}$	Shock to Relative GDP Deflator Trend	%
$\varepsilon^{\Delta\overline{reer}}$	Shock to Real Exchange Rate Trend	%
$\varepsilon^{\overline{remit}^{rat}}$	Shock to Remittances Trend	%
$\varepsilon^{\widehat{remit}^{rat}}$	Shock to Remittances Gap	%
$\varepsilon^{\overline{oth}^{rat}}$	Shock to Other Income Trend	%
$\varepsilon^{\widehat{oth}^{rat}}$	Shock to Other Income Gap	%
$\varepsilon^{i^{pol}}$	Shock to Monetary Policy Rate	%
ε^{i^M}	Shock to Market rate	%
ε^{s}	Shock to Nominal Exchange Rate	%
$\varepsilon^{\widehat{prem}}$	Shock to Risk Premium Gap	%
$\varepsilon^{\overline{prem}}$	Shock to Risk Premium Trend	%
$\varepsilon^{fxi^{rat}}$	Shock to FX-intervention	%
$\varepsilon^{fxa^{rat}}$	Shock to Reserve Accumulation	%
$\varepsilon^{\overline{fxres}^{ratimp}}$	Shock to FX-reserve Trend	%
$\varepsilon^{\tau^{CFM,Admin}}$	Shock to Administrative CFM	%
$\varepsilon^{\tau^{CFM,Flow}}$	Shock to Flow CFM	%
$\varepsilon^{tprem^{dom}}$	Shock to LCY Term Premium	%
$\varepsilon^{tprem^{*}}$	Shock to FCY Term Premium	%
$\varepsilon^{debt1Y^{d,rat}}$	Shock to 1Y LCY New Debt issuance	%
$\varepsilon^{debt1Y^{f,rat}}$	Shock to 1Y FCY New Debt issuance	%
$\varepsilon^{def^{rat}}$	Shock to Total Deficit	%
$\varepsilon^{defstruct^{rat}}$	Shock to Cyclically Adjusted Primary Deficit	%
$\varepsilon^{debt^{rat,TAR}}$	Shock to Public Debt Target	%
ε^{θ}	Shock to LCY Debt issuance share	%
$\varepsilon^{\Delta\overline{rpc}^{oil}}$	Shock to Oil Price Trend	%
$\varepsilon^{\widehat{rpc}^{oil}}$	Shock to Oil Price Gap	%
$\varepsilon^{\Delta\overline{rpc}^{food}}$	Shock to Food Price Trend	%
$\varepsilon^{\widehat{rpc}^{food}}$	Shock to Food Price Gap	%
$\varepsilon^{of^{rat}}$	Shock to Other Fiscal Expenditures	%
$\varepsilon^{gi^{rat}}$	Shock to Government Investment	%
$\varepsilon^{tr^{rat}}$	Shock to Government Transfer	%
$\varepsilon^{i^{US}}$	Shock to US FED Interest Rate	%
$\varepsilon^{\bar{r}^{US}}$	Shock to US Real Interest Rate Trend	%
	j={US,EZ,CN,JP,RC}	
$\varepsilon^{\Delta cpi^j}$	Shock to Trading partners CPI	%
$\varepsilon^{\hat{y}^j}$	Shock to Trading partners Output Gap	%
	j={EZ,CN,JP,RC}	
$\varepsilon^{\Delta s^j}$	Shock to Trading partners NER	%
$\varepsilon^{\widehat{re}^j}$	Shock to Trading partners RER	%

Appendix B: Model Equations

B.1 Real Aggregate Demand

Consumption gap equation:

$$\hat{c}_t = a_1 \hat{c}_{t-1} + a_2 E_t \hat{c}_{t+1} - a_3(a_4 \hat{r}_t^L + (1-a_4)\hat{r}_t + a_5 \widehat{prem}_t) + a_6\left(\hat{y}_t + a_7\left(\frac{\bar{x}_t^{rat}}{100}\widehat{rp}_t^X - \frac{\bar{m}_t^{rat}}{100}\widehat{rp}_t^M\right)\right) + a_8\widehat{remit}_t^{rat} - a_9\widehat{rev}_t + a_{10}(\widehat{wr}_t + \widehat{rp}_t^{core} - \widehat{rp}_t^C) + a_{11}\varepsilon_t^{\widehat{ncr}^{h,rat}} + \varepsilon_t^{\hat{c}}$$

Investment gap equation:

$$\widehat{inv}_t = a_{12}\widehat{inv}_{t-1} + a_{13}E_t\widehat{inv}_{t+1} + a_{14}\hat{q}_t - a_{15}\widehat{rp}_t^{inv} + a_{16}\widehat{gi}_t^{rat} + a_{17}\varepsilon_t^{\widehat{ncr}^{f,rat}} + \varepsilon_t^{\widehat{inv}}$$

Tobin-Q equation:

$$\hat{q}_t = a_{18}(E_t\hat{y}_{t+1} + a_{19}E_t\widehat{zh}_{t+1}) - a_{20}(a_{21}\hat{r}_t + a_{22}\hat{r}_t^L + (1 - a_{21} - a_{22})\widehat{prem}_t) + a_{23}E_t\hat{q}_{t+1}$$

Government consumption gap equation:

$$\widehat{gc}_t = a_{24}\widehat{gc}_{t-1} + \varepsilon_t^{\widehat{gc}}$$

Export gap equation:

$$\hat{x}_t = a_{25}\hat{x}_{t-1} + a_{26}(\widehat{reer}_t - a_{27}\widehat{rp}_t^X) + a_{28}\hat{y}_t^W + \varepsilon_t^{\hat{x}}$$

Import gap equation:

$$\hat{m}_t = a_{29}\hat{m}_{t-1} + (1-a_{29})(a_{30}(\hat{c}_t - a_{31}\widehat{reer}_t) + a_{32}\widehat{gc}_t + a_{33}\widehat{inv}_t + (1 - a_{30} - a_{32} - a_{33})\hat{x}_t) + \varepsilon_t^{\hat{m}}$$

Potential GDP growth:

$$\Delta\bar{y}_t = \rho^{\Delta\bar{y}}\Delta\bar{y}_{t-1} + (1-\rho^{\Delta\bar{y}})\Delta y^{SS} + \varepsilon_t^{\Delta\bar{y}}$$

Consumption trend growth:

$$\Delta\bar{c}_t = \rho^{\Delta\bar{c}}\Delta\bar{c}_{t-1} + (1-\rho^{\Delta\bar{c}})(\Delta\overline{rp}_t^y + \Delta\bar{y}_t - \Delta\overline{rp}_t^c) - \delta^{\Delta\bar{c}}(\bar{c}_t^{rat} - c^{rat,SS}) + \varepsilon_t^{\Delta\bar{c}}$$

Investment trend growth:

$$\Delta\overline{inv}_t = \rho^{\Delta\overline{inv}}\Delta\overline{inv}_{t-1} + (1-\rho^{\Delta\overline{inv}})\left(\Delta\overline{rp}_t^y + \Delta\bar{y}_t - \Delta\overline{rp}_t^{inv}\right) - \delta^{\Delta\overline{inv}}(\overline{inv}_t^{rat} - inv^{rat,SS}) + \varepsilon_t^{\Delta\overline{inv}}$$

Government consumption trend growth:

$$\Delta\overline{gc}_t = \rho^{\Delta\overline{gc}}\Delta\overline{gc}_{t-1} + (1-\rho^{\Delta\overline{gc}})(\Delta\overline{rp}_t^y + \Delta\bar{y}_t - \Delta\overline{rp}_t^{gc}) - \delta^{\Delta\overline{gc}}(\overline{gc}_t^{rat} - gc^{rat,SS}) + \varepsilon_t^{\Delta\overline{gc}}$$

Export trend growth:

$$\Delta\bar{x}_t = \rho^{\Delta\bar{x}}\Delta\bar{x}_{t-1} + (1-\rho^{\Delta\bar{x}})(\Delta\overline{rp}_t^y + \Delta\bar{y}_t - \Delta\overline{rp}_t^x) - \delta^{\Delta\bar{x}}(\bar{x}_t^{rat} - x^{rat,SS}) + \varepsilon_t^{\Delta\bar{x}}$$

Import trend growth:

$$\Delta\bar{y}_t = \frac{\bar{c}_{t-1}^{rat}}{100}\Delta\bar{c}_t + \frac{\overline{inv}_{t-1}^{rat}}{100}\Delta\overline{inv}_t + \frac{\overline{gc}_{t-1}^{rat}}{100}\Delta\overline{gc}_t + \frac{\bar{x}_{t-1}^{rat}}{100}\Delta\bar{x}_t - \frac{\bar{m}_{t-1}^{rat}}{100}\Delta\bar{m}_t + \varepsilon_t^{\bar{y}}$$

Gap and trend identities:

$c_t = \bar{c}_t + \hat{c}_t$

$inv_t = \overline{inv}_t + \widehat{inv}_t$

$gc_t = \overline{gc}_t + \widehat{gc}_t$

$x_t = \bar{x}_t + \hat{x}_t$

$m_t = \bar{m}_t + \hat{m}_t$

$y_t = \bar{y}_t + \hat{y}_t$

Annualized q-o-q growth rates:

$\Delta y_t = (y_t - y_{t-1}) \times 4$

$\Delta c_t = (c_t - c_{t-1}) \times 4$

$\Delta inv_t = (inv_t - inv_{t-1}) \times 4$

$\Delta gc_t = (gc_t - gc_{t-1}) \times 4$

$\Delta x_t = (x_t - x_{t-1}) \times 4$

$\Delta m_t = (m_t - m_{t-1}) \times 4$

$\Delta \bar{y}_t = (\bar{y}_t - \bar{y}_{t-1}) \times 4$

$\Delta \bar{c}_t = (\bar{c}_t - \bar{c}_{t-1}) \times 4$

$\Delta \overline{inv}_t = (\overline{inv}_t - \overline{inv}_{t-1}) \times 4$

$\Delta \overline{gc}_t = (\overline{gc}_t - \overline{gc}_{t-1}) \times 4$

$\Delta \bar{x}_t = (\bar{x}_t - \bar{x}_{t-1}) \times 4$

$\Delta \bar{m}_t = (\bar{m}_t - \bar{m}_{t-1}) \times 4$

Y-o-Y growth rate:

$\Delta^4 y_t = y_t - y_{t-4}$

$\Delta^4 c_t = c_t - c_{t-4}$

$\Delta^4 inv_t = inv_t - inv_{t-4}$

$\Delta^4 gc_t = gc_t - gc_{t-4}$

$\Delta^4 x_t = x_t - x_{t-4}$

$\Delta^4 m_t = m_t - m_{t-4}$

$\Delta^4 \bar{y}_t = \bar{y}_t - \bar{y}_{t-4}$

$\Delta^4 \bar{c}_t = \bar{c}_t - \bar{c}_{t-4}$

$\Delta^4 \overline{inv}_t = \overline{inv}_t - \overline{inv}_{t-4}$

$\Delta^4 \overline{gc}_t = \overline{gc}_t - \overline{gc}_{t-4}$

$\Delta^4 \bar{x}_t = \bar{x}_t - \bar{x}_{t-4}$

$\Delta^4 \bar{m}_t = \bar{m}_t - \bar{m}_{t-4}$

Great ratios (in nominal GDP):

$100 = c_t^{rat} + inv_t^{rat} + gc_t^{rat} + x_t^{rat} - m_t^{rat}$

$c_t^{rat} = \frac{RP_t^C}{RP_t^Y} \frac{C_t}{Y_t} \times 100$

$inv_t^{rat} = \frac{RP_t^{Inv}}{RP_t^Y} \frac{Inv_t}{Y_t} \times 100$

$gc_t^{rat} = \frac{RP_t^{Gc}}{RP_t^Y} \frac{Gc_t}{Y_t} \times 100$

$x_t^{rat} = \frac{RP_t^X}{RP_t^Y} \frac{X_t}{Y_t} \times 100$

Great rations in for trends (in nominal trend GDP):

$100 = \bar{c}_t^{rat} + \overline{inv}_t^{rat} + \overline{gc}_t^{rat} + \bar{x}_t^{rat} - \bar{m}_t^{rat}$

$\bar{c}_t^{rat} = \frac{\overline{RP}_t^{C}}{\overline{RP}_t^{Y}} \frac{\bar{C}_t}{\bar{Y}_t}$ x 100

$\overline{inv}_t^{rat} = \frac{\overline{RP}_t^{Inv}}{\overline{RP}_t^{Y}} \frac{\overline{Inv}_t}{\bar{Y}_t}$ x 100

$\overline{gc}_t^{rat} = \frac{\overline{RP}_t^{Gc}}{\overline{RP}_t^{Y}} \frac{\overline{Gc}_t}{\bar{Y}_t}$ x 100

$\bar{x}_t^{rat} = \frac{\overline{RP}_t^{X}}{\overline{RP}_t^{Y}} \frac{\bar{X}_t}{\bar{Y}_t}$ x 100

Output gap:

$$\hat{y}_t = \frac{\bar{c}_t^{rat}}{100}\hat{c}_t + \frac{\overline{inv}_t^{rat}}{100}\widehat{inv}_t + \frac{\overline{gc}_t^{rat}}{100}\widehat{gc}_t + \frac{\bar{x}_t^{rat}}{100}\hat{x}_t - \frac{\bar{m}_t^{rat}}{100}\widehat{m}_t + \varepsilon_t^{\hat{y}}$$

B.2 Labor Market Block

Nominal Business Wage Phillips Curve:

$$\Delta w_t^B = \sigma_1 \Delta w_{t-1}^B + (1-\sigma_1)E_t \Delta w_{t+1}^B + \sigma_2(\sigma_3 \hat{c}_t - \sigma_4 \widehat{wr}_t) + \sigma_5 \varepsilon_t^{\Delta w^M} + \varepsilon_t^{\Delta w^B}$$

Minimum wage:

$$w_t^M = w_{t-1}^M + \varepsilon_t^{\Delta w^M}$$

Average nominal wage:

$$w_t = \sigma_6 w_t^M + (1-\sigma_6) w_t^B$$

Real wage:

$$wr_t = w_t - cpi_t^{core}$$

Growth of trend real wage:

$$\Delta\overline{wr}_t = \sigma_7 \Delta\overline{wr}_{t-1} + (1-\sigma_7)(\Delta wr^{SS} + \sigma_8(\Delta\bar{y}_t - \Delta y^{SS})) + \varepsilon_t^{\Delta\overline{wr}}$$

Okun's law, the unemployment rate gap:

$$\widehat{une}_t = \sigma_9 \widehat{une}_{t-1} + \sigma_{10}\hat{y}_{t-1} + \varepsilon_t^{\widehat{une}}$$

NAIRU, non-accelerating rate of unemployment:

$$\overline{une}_t = \sigma_{11}\overline{une}_{t-1} + (1-\sigma_{11})\left(\overline{une}^{ss} - \sigma_{12}(\Delta\bar{y}_t - \Delta y^{SS})\right) + \varepsilon_t^{\overline{une}}$$

Gap and trend identities:

$$wr_t = \overline{wr}_t + \widehat{wr}_t$$

$$une_t = \overline{une}_t + \widehat{une}_t$$

Annualized q-o-q growth rates:

$\Delta w_t = (w_t - w_{t-1})$ x 4

$\Delta wr_t = (wr_t - wr_{t-1})$ x 4

$\Delta\bar{w}_t = (\bar{w}_t - \bar{w}_{t-1})$ x 4

$$\Delta\overline{wr}_t = (\overline{wr}_t - \overline{wr}_{t-1})\ x\ 4$$

Y-o-Y growth rate:

$$\Delta^4 w_t = w_t - w_{t-4}$$
$$\Delta^4 \overline{w}_t = \overline{w}_t - \overline{w}_{t-4}$$
$$\Delta^4 \overline{wr}_t = \overline{wr}_t - \overline{wr}_{t-4}$$

B.3 Banking Sector and Credit Block

Outstanding credit:

$$cr_t^{rat} = cr_t^{h,rat} + cr_t^{f,rat}$$

Households' outstanding credit:

$$cr_t^{h,rat} = (1-\delta^h)cr_{t-1}^{h,rat} / \exp\left(\Delta\overline{gdp}_t^{nom}/400\right) + ncr_t^{h,rat} + \varepsilon_t^{cr\,h,rat}$$

Firms' outstanding credit:

$$cr_t^{f,rat} = (1-\delta^f)cr_{t-1}^{f,rat} / \exp\left(\Delta\overline{gdp}_t^{nom}/400\right) + ncr_t^{f,rat} + \varepsilon_t^{cr\,f,rat}$$

Total new credit:

$$ncr_t^{rat} = ncr_t^{h,rat} + ncr_t^{f,rat}$$

Households' new credit gap and trend decomposition:

$$ncr_t^{h,rat} = \overline{ncr}_t^{h,rat} + \widehat{ncr}_t^{h,rat}$$

Households' new credit gap (demand):

$$\widehat{ncr}_t^{h,rat} = \rho^{\widehat{ncr}^{h,rat}}\widehat{ncr}_{t-1}^{h,rat} + \alpha^{\widehat{ncr}^{h,rat}}\hat{c}_t - \beta^{\widehat{ncr}^{h,rat}}\hat{r}_t^L + \varepsilon_t^{\widehat{ncr}^{h,rat}}$$

Households' new credit trend (demand):

$$\overline{ncr}_t^{h,rat} = \rho^{\overline{ncr}^{h,rat}}\overline{ncr}_{t-1}^{h,rat} + \left(1-\rho^{\overline{ncr}^{h,rat}}\right)(1-s^{cr,f})\left(cr^{rat,ss} - (1-\delta^h)cr^{rat,ss} / \exp\left(\Delta\overline{gdp}_t^{nom}/400\right)\right) + \varepsilon_t^{\overline{ncr}^{h,rat}}$$

Firms' new credit gap and trend decomposition:

$$ncr_t^{f,rat} = \overline{ncr}_t^{f,rat} + \widehat{ncr}_t^{f,rat}$$

Firms' new credit gap (demand):

$$\widehat{ncr}_t^{f,rat} = \rho^{\widehat{ncr}^{f,rat}}\widehat{ncr}_{t-1}^{f,rat} + \left(1-\rho^{\widehat{ncr}^{f,rat}}\right)\max\left\{ltv\left(\widehat{zh}_t - \widehat{zh}_{t-1} - \beta^{\widehat{ncr}^{f,rat}}\hat{r}_t^L\right),\ -ncr_t^{f,ss,rat}\right\} + \varepsilon_t^{\widehat{ncr}^{f,rat}}$$

Firms' new credit gap (demand):

$$\overline{ncr}_t^{f,rat} = \rho^{\overline{ncr}^{f,rat}}\overline{ncr}_{t-1}^{f,rat} + \left(1-\rho^{\overline{ncr}^{f,rat}}\right)s^{cr,f}\left(cr^{rat,ss} - (1-\delta^f)cr^{rat,ss} / \exp\left(\Delta\overline{gdp}_t^{nom}/400\right)\right) + \varepsilon_t^{\overline{ncr}^{f,rat}}$$

Credit interest rate (demand):

$$rs_t^L = \rho^{rs^L} rs_{t-1}^L + \left(1-\rho^{rs^L}\right)(rs_t^{1Y} + prem_t^c) + \varepsilon_t^{rs^L}$$

Credit real interest rate:

$r_t^L = rs_t^L - \Delta^4 cpi_{t+4}$

Credit real interest rate decomposition:

$r_t^L = \bar{r}_t^L + \hat{r}_t^L$

Credit real interest rate HP-trend

$r_t^L = \lambda^{HP}\bar{r}_{t-2}^{L,HP} - 4\cdot\lambda^{HP}\bar{r}_{t-1}^{L,HP} + (6\cdot\lambda^{HP}+1)\cdot\bar{r}_t^{L,HP} - 4\cdot\lambda^{HP}E_t\bar{r}_{t+1}^{L,HP} + \lambda^{HP}E_t\bar{r}_{t+2}^{L,HP}$

Credit real interest rate trend

$\bar{r}_t^L = \omega^{HP}\bar{r}_t^{L,HP} + (1-\omega^{HP})(\bar{r}_t + tprem^{d,ss} + prem^{ss,cc})$

Credit premium:

$prem_t^c = prem_t^{cc} + bspread_t$

Market Risk Premium of Credit:

$prem_t^{cc} = \rho^{prem^{cc}} prem_{t-1}^{cc} + \left(1-\rho^{prem^{cc}}\right)(-\alpha_1^{prem,cc}E_t\hat{y}_{t+1} + \alpha_2^{prem,cc}\widehat{prem}_t + prem^{ss,cc}) + \varepsilon_t^{prem^{cc}}$

Borrower default-risk:

$bspread_t = -f_o(bc_t^{ta} - bc_t^{ta,TAR}) + \varepsilon_t^{bspread}$

Asset prices:

$\widehat{zh}_t = \rho^{\widehat{zh}}\widehat{zh}_{t-1} + \left(1-\rho^{\widehat{zh}}\right)\beta^{\widehat{zh}}E_t\widehat{zh}_{t+1} + \alpha_1^{\widehat{zh}}\left(\hat{y}_t - \alpha_2^{\widehat{zh}}\hat{r}_t^L\right) + \varepsilon_t^{\widehat{zh}}$

Total assets of the commercial banks:

$ta_t^{rat} = cr_t^{rat} + ta^{wedge,rat} + \varepsilon_t^{ta}$

Commercial Bank capital accumulation:

$bc_t^{ta} = bc_{t-1}^{ta}/\exp(\Delta ta_t/400) + roa_t - div_t^{ta} + \varepsilon_t^{bc}$

Return on Assets:

$roa_t = (1-rrr)(rs_t^L - rs_t)/4 + cost^{adj} + \varepsilon_t^{roa}$

Lending rate spread:

$bspread_t = -f_o\left(bc_t^{ta} - bc_t^{ta,TAR}\right) + \varepsilon_t^{bspread}$

Dividend to Total Assets:

$div_t^{ta} = \max\left\{(1-rrr)div^{ss,ta} + bc_t^{ta} - bc_t^{ta,TAR}, 0\right\} + \varepsilon_t^{div}$

Total Asset target:

$bc_t^{ta,tar} = \rho^{bc^{ta,tar}} bc_{t-1}^{ta,tar} + \left(1-\rho^{bc^{ta,tar}}\right)\left(bc^{ss,ta,rat} + \phi(cr_t^{rat} - cr^{ss,rat})\right) + \varepsilon_t^{bc,ta,tar}$

Credit costs:

$cost^{adj} = bc^{ss,ta,rat}\left(1 - 1/\exp\left(\Delta\overline{gdp}_t^{nom}/400\right)\right) + (1-rr)(div^{ta,ss} - prem^{ss,cc}/4 - tprem^{d,ss}/4)$

Total assets in terms of nominal GDP:
$ta_t^{rat} = \frac{ta_t}{CPI_t \overline{RP}_t^Y \bar{Y}_t}$ x 100

Annualized q-o-q growth rates:
$\Delta ta_t = (ta_t - ta_{t-1})$ x 4

B.4 Aggregate Supply

Headline CPI:
$cpi_t = w^{cpi,food} cpi_t^{food} + w^{cpi,energy} cpi_t^{energy} + (1 - w^{cpi,food} - w^{cpi,energy}) cpi_t^{core} + \epsilon_t^{cpi}$

Level shock to CPI-components:
$\epsilon_t^{cpi} = \epsilon_{t-1}^{cpi} + \varepsilon_t^{cpi}$

Core inflation Phillips-curve:
$\Delta cpi_t^{core} = b_1 \Delta cpi_{t-1}^{core} + (1 - b_1) E_t \Delta cpi_{t+1}^{core} + rmc_t^{core} + \varepsilon_t^{\Delta cpi^{core}}$

Real marginal cost of core inflation:
$rmc_t^{core} = b_2 \hat{y}_t + b_3(\widehat{reer}_t - \widehat{rp}_t^{core}) + b_4(\widehat{rp}_t^{energy} - \widehat{rp}_t^{core}) + b_5(\widehat{rp}_t^{food} - \widehat{rp}_t^{core}) + b_6 \widehat{wr}_t$

Food inflation Phillips-curve:
$\Delta cpi_t^{food} = b_7 \Delta cpi_{t-1}^{food} + (1 - b_7) E_t \Delta cpi_{t+1}^{food} + b_8(\widehat{rpc}_t^{food} + \widehat{re}_t^{US} - \widehat{rp}_t^{food}) + \varepsilon_t^{\Delta cpi^{food}}$

Energy inflation Phillips-curve:
$\Delta cpi_t^{energy} = b_9 \Delta cpi_{t-1}^{energy} + (1 - b_9) E_t \Delta cpi_{t+1}^{energy} + b_{10}(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^{energy}) + \varepsilon_t^{\Delta cpi^{energy}}$

Relative price of core CPI:
$rp_t^{core} = cpi_t^{core} - (cpi_t - \epsilon_t^{cpi})$

Trend and gap decomposition of relative price of core CPI:
$rp_t^{core} = \overline{rp}_t^{core} + \widehat{rp}_t^{core}$

Core CPI relative price trend:
$\Delta \overline{rp}_t^{core} = \rho^{\Delta \overline{rp}^{core}} \Delta \overline{rp}_{t-1}^{core} + (1 - \rho^{\Delta \overline{rp}^{core}}) \Delta rp^{core,ss} + \varepsilon_t^{\Delta \overline{rp}^{core}}$

Implicit inflation target for Core CPI:
$\Delta cpi_t^{core,TAR} = \Delta cpi_t^{TAR} + \Delta \overline{rp}_t^{core}$

Relative price of food CPI:
$rp_t^{food} = cpi_t^{food} - (cpi_t - \epsilon_t^{cpi})$

Trend and gap decomposition of relative price of food CPI:

$rp_t^{food} = \overline{rp}_t^{food} + \widehat{rp}_t^{food}$

Food CPI relative price trend:

$\Delta\overline{rp}_t^{food} = \rho^{\Delta\overline{rp}^{food}} \Delta\overline{rp}_{t-1}^{food} + \left(1 - \rho^{\Delta\overline{rp}^{food}}\right) \Delta rp^{food,ss} + \varepsilon_t^{\Delta\overline{rp}^{food}}$

Implicit inflation target for food CPI:

$\Delta cpi_t^{food,TAR} = \Delta cpi_t^{TAR} + \Delta\overline{rp}_t^{food}$

Relative price of energy CPI:

$rp_t^{energy} = cpi_t^{energy} - \left(cpi_t - \epsilon_t^{cpi}\right)$

Trend and gap decomposition of relative price of energy CPI:

$rp_t^{energy} = \overline{rp}_t^{energy} + \widehat{rp}_t^{energy}$

Energy CPI relative price trend:

$0 = w^{cpi,food}\overline{rp}_t^{food} + w^{cpi,energy}\overline{rp}_t^{energy} + (1 - w^{cpi,food} - w^{cpi,energy})\overline{rp}_t^{core} + \varepsilon_t^{rp}$

Implicit inflation target for energy CPI:

$\Delta cpi_t^{energy,TAR} = \Delta cpi_t^{TAR} + \Delta\overline{rp}_t^{energy}$

Q-o-Q changes of CPIs and relative price:

$\Delta cpi_t = (cpi_t - cpi_{t-1})$ x 4

$\Delta cpi_t^{core} = (cpi_t^{core} - cpi_{t-1}^{core})$ x 4

$\Delta cpi_t^{food} = (cpi_t^{food} - cpi_{t-1}^{food})$ x 4

$\Delta cpi_t^{energy} = (cpi_t^{energy} - cpi_{t-1}^{energy})$ x 4

$\Delta\overline{rp}_t^{core} = (\overline{rp}_t^{core} - \overline{rp}_{t-1}^{core})$ x 4

$\Delta\overline{rp}_t^{food} = (\overline{rp}_t^{food} - \overline{rp}_{t-1}^{food})$ x 4

$\Delta\overline{rp}_t^{energy} = (\overline{rp}_t^{energy} - \overline{rp}_{t-1}^{energy})$ x 4

Y-o-Y changes of CPI:

$\Delta^4 cpi_t = cpi_t - cpi_{t-4}$

$\Delta^4 cpi_t^{core} = cpi_t^{core} - cpi_{t-4}^{core}$

$\Delta^4 cpi_t^{food} = cpi_t^{food} - cpi_{t-4}^{food}$

$\Delta^4 cpi_t^{energy} = cpi_t^{energy} - cpi_{t-4}^{energy}$

B.5 GDP Deflators

Consumption deflator (measurement equation):

$\Delta p_t^C = \Delta cpi_t + \Delta\overline{rp}_t^C - d_1\widehat{rp}_t^C + \varepsilon_t^{\Delta p^C}$

Investment deflator Phillips-curve:

$\Delta p_t^{Inv} = d_2\Delta p_{t-1}^{Inv} + (1 - d_2)E_t\Delta p_{t+1}^{Inv} + d_3 rmc_t^{Inv} + \varepsilon_t^{\Delta p^{Inv}}$

Real marginal cost of investment deflator:

$$rmc_t^{Inv} = d_4\widehat{inv}_t + d_5\left(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^{Inv}\right) + (1 - d_4 - d_5)(\widehat{reer}_t - \widehat{rp}_t^{Inv})$$

Government consumption deflator Phillips-curve:

$$\Delta p_t^{Gc} = d_6\Delta p_{t-1}^{Gc} + (1 - d_6)E_t\Delta p_{t+1}^{Gc} + d_7 rmc_t^{Gc} + \varepsilon_t^{\Delta p^{Gc}}$$

Real marginal cost of government consumption deflator:

$$rmc_t^{Gc} = d_8\widehat{gc}_t + d_9\left(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^{Gc}\right) + (1 - d_8 - d_9)(\widehat{reer}_t - \widehat{rp}_t^{Gc})$$

Export deflator Phillips-curve:

$$\Delta p_t^X = d_{10}\Delta p_{t-1}^X + (1 - d_{10})E_t\Delta p_{t+1}^X + d_{11} rmc_t^X + \varepsilon_t^{\Delta p^X}$$

Real marginal cost of export deflator:

$$rmc_t^X = d_{12}\hat{x}_t + d_{13}\left(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^X\right) + (1 - d_{12} - d_{13})(\widehat{reer}_t - \widehat{rp}_t^X)$$

Import deflator Phillips-curve:

$$\Delta p_t^M = d_{14}\Delta p_{t-1}^M + (1 - d_{14})E_t\Delta p_{t+1}^M + d_{15} rmc_t^M + \varepsilon_t^{\Delta p^M}$$

Real marginal cost of import deflator:

$$rmc_t^M = d_{16}\widehat{m}_t + d_{17}\left(\widehat{rpc}_t^{oil} + \widehat{re}_t^{US} - \widehat{rp}_t^M\right) + d_{18}\left(\widehat{rpc}_t^{food} + \widehat{re}_t^{US} - \widehat{rp}_t^M\right) + (1 - d_{16} - d_{17} - d_{18})(\widehat{reer}_t - \widehat{rp}_t^M)$$

Relative price gap of GDP deflator:

$$\widehat{rp}_t^{GDP} = \frac{\bar{c}_t^{rat}}{100}\widehat{rp}_t^C + \frac{\overline{inv}_t^{rat}}{100}\widehat{rp}_t^{Inv} + \frac{\overline{gc}_t^{rat}}{100}\widehat{rp}_t^{Gc} + \frac{\bar{x}_t^{rat}}{100}\widehat{rp}_t^X - \frac{\bar{m}_t^{rat}}{100}\widehat{rp}_t^M + \varepsilon_t^{\widehat{rp}^{GDP}}$$

Relative price trend of GDP deflator:

$$\Delta\overline{rp}_t^{GDP} = \frac{\bar{c}_{t-1}^{rat}}{100}\Delta\overline{rp}_t^C + \frac{\overline{inv}_{t-1}^{rat}}{100}\Delta\overline{rp}_t^{Inv} + \frac{\overline{gc}_{t-1}^{rat}}{100}\Delta\overline{rp}_t^{Gc} + \frac{\bar{x}_{t-1}^{rat}}{100}\Delta\overline{rp}_t^X - \frac{\bar{m}_{t-1}^{rat}}{100}\Delta\overline{rp}_t^M + \varepsilon_t^{\Delta\overline{rp}^{GDP}}$$

Relative price trend of consumption deflator:

$$\Delta\overline{rp}_t^C = \rho^{\Delta\overline{rp}^C}\Delta\overline{rp}_{t-1}^C + \left(1 - \rho^{\Delta\overline{rp}^C}\right)\Delta rp^{C,ss} + \varepsilon_t^{\Delta\overline{rp}^C}$$

Relative price trend of investment deflator:

$$\Delta\overline{rp}_t^{Inv} = \rho^{\Delta\overline{rp}^{Inv}}\Delta\overline{rp}_{t-1}^{Inv} + \left(1 - \rho^{\Delta\overline{rp}^{Inv}}\right)\Delta rp^{Inv,ss} + \varepsilon_t^{\Delta\overline{rp}^{Inv}}$$

Relative price trend of government consumption deflator:

$$\Delta\overline{rp}_t^{Gc} = \rho^{\Delta\overline{rp}^{Gc}}\Delta\overline{rp}_{t-1}^{Gc} + \left(1 - \rho^{\Delta\overline{rp}^{Gc}}\right)\Delta rp^{Gc,ss} + \varepsilon_t^{\Delta\overline{rp}^{Gc}}$$

Relative price trend of export deflator:

$$\Delta\overline{rp}_t^X = \rho^{\Delta\overline{rp}^X}\Delta\overline{rp}_{t-1}^X + \left(1 - \rho^{\Delta\overline{rp}^X}\right)\Delta rp^{X,ss} + \varepsilon_t^{\Delta\overline{rp}^X}$$

Relative price trend of import deflator:

$$\Delta\overline{rp}_t^M = \rho^{\Delta\overline{rp}^M}\Delta\overline{rp}_{t-1}^M + \left(1 - \rho^{\Delta\overline{rp}^M}\right)\Delta rp^{M,ss} + \varepsilon_t^{\Delta\overline{rp}^M}$$

Relative price of deflators:

$rp_t^{GDP} = p_t^{GDP} - cpi_t$

$rp_t^{C} = p_t^{C} - cpi_t$

$rp_t^{Inv} = p_t^{Inv} - cpi_t$

$rp_t^{Gc} = p_t^{Gc} - cpi_t$

$rp_t^{X} = p_t^{X} - cpi_t$

$rp_t^{M} = p_t^{M} - cpi_t$

Trend and gap decomposition of relative price of deflators:

$rp_t^{GDP} = \overline{rp}_t^{GDP} + \widehat{rp}_t^{GDP}$

$rp_t^{C} = \overline{rp}_t^{C} + \widehat{rp}_t^{C}$

$rp_t^{Inv} = \overline{rp}_t^{Inv} + \widehat{rp}_t^{Inv}$

$rp_t^{Gc} = \overline{rp}_t^{Gc} + \widehat{rp}_t^{Gc}$

$rp_t^{X} = \overline{rp}_t^{X} + \widehat{rp}_t^{X}$

$rp_t^{M} = \overline{rp}_t^{M} + \widehat{rp}_t^{M}$

Q-o-Q changes of CPIs and relative price:

$\Delta p_t^{GDP} = (p_t^{GDP} - p_{t-1}^{GDP}) \text{ x } 4$

$\Delta p_t^{C} = (p_t^{C} - p_{t-1}^{C}) \text{ x } 4$

$\Delta p_t^{Inv} = (p_t^{Inv} - p_{t-1}^{Inv}) \text{ x } 4$

$\Delta p_t^{Gc} = (p_t^{Gc} - p_{t-1}^{Gc}) \text{ x } 4$

$\Delta p_t^{X} = (p_t^{X} - p_{t-1}^{X}) \text{ x } 4$

$\Delta p_t^{M} = (p_t^{M} - p_{t-1}^{M}) \text{ x } 4$

$\Delta \overline{rp}_t^{GDP} = (\overline{rp}_t^{GDP} - \overline{rp}_{t-1}^{GDP}) \text{ x } 4$

$\Delta \overline{rp}_t^{C} = (\overline{rp}_t^{C} - \overline{rp}_{t-1}^{C}) \text{ x } 4$

$\Delta \overline{rp}_t^{Inv} = (\overline{rp}_t^{Inv} - \overline{rp}_{t-1}^{Inv}) \text{ x } 4$

$\Delta \overline{rp}_t^{Gc} = (\overline{rp}_t^{Gc} - \overline{rp}_{t-1}^{Gc}) \text{ x } 4$

$\Delta \overline{rp}_t^{X} = (\overline{rp}_t^{X} - \overline{rp}_{t-1}^{X}) \text{ x } 4$

$\Delta \overline{rp}_t^{M} = (\overline{rp}_t^{M} - \overline{rp}_{t-1}^{M}) \text{ x } 4$

Nominal GDP:

$gdp_t^{nom} = y_t + p_t^{GDP}$

$\Delta gdp_t^{nom} = (gdp_t^{nom} - gdp_{t-1}^{nom}) \text{ x } 4$

$\Delta^4 gdp_t^{nom} = (gdp_t^{nom} - gdp_{t-4}^{nom})$

Nominal GDP trend:

$\Delta \overline{gdp}_t^{nom} = \Delta \bar{y}_t + \Delta cpi_t^{TAR} + \Delta \overline{rp}_t^{GDP}$

$\Delta \overline{gdp}_t^{nom} = (\overline{gdp}_t^{nom} - \overline{gdp}_{t-1}^{nom}) \text{ x } 4$

$\Delta^4 \overline{gdp}_t^{nom} = (\overline{gdp}_t^{nom} - \overline{gdp}_{t-4}^{nom})$

B.6 Real Interest Rate and Exchange Rate

Real interest rate identity:

$r_t = i_t - [\theta \Delta^4 cpi_t + (1-\theta) E_t \Delta^4 cpi_{t+4}]$

Real exchange rate (PPP) identity:
$reer_t = s_t + cpi_t^* - cpi_t$

Real exchange rate trend:
$\Delta\overline{reer}_t = \rho^{\Delta\overline{reer}}\Delta\overline{reer}_{t-1} + (1-\rho^{\Delta\overline{reer}})\Delta reer^{ss} + \varepsilon_t^{\Delta\overline{reer}}$

Real exchange rate gap:
$\widehat{reer}_t = reer_t - \overline{reer}_t$

Q-o-Q change of Real exchange rate trend
$\Delta\overline{reer}_t = (\overline{reer}_t - \overline{reer}_{t-1})$ x 4

Real uncovered interest rate parity condition:
$\bar{r}_t = \bar{r}_t^{US} + \overline{prem}_t + E_t\Delta\overline{re}_{t+1}$

Real interest rate gap:
$\hat{r}_t = r_t - \bar{r}_t$

Bilateral real exchange rate gap vis-à-vis with USD:

$$\widehat{re}_t = \widehat{reer}_t + \sum_{EZ,CN,JP,RC} w^{trade^j}\widehat{re}_t^j$$

Bilateral real exchange rate trend vis-à-vis with USD:

$$\Delta\overline{re}_t = \Delta\overline{reer}_t + \sum_{EZ,CN,JP,RC} w^{trade^j}\Delta\overline{re}_t^j$$

Effective foreign price in USD:

$$cpi_t^* = w^{trade^{US}} cpi_t^{US} + \sum_{EZ,CN,JP,RC} w^{trade^j}(cpi_t^j - s_t^j)$$

Implicit depreciation trend (PPP condition with trends):
$\Delta\bar{s}_t = \Delta\overline{re}_t + \Delta cpi_t^{TAR} - \Delta cpi^{US,ss}$

Annual growth rate of nominal exchange rate trend:
$\Delta^4\bar{s}_t = (\Delta\bar{s}_t + \Delta\bar{s}_{t-1} + \Delta\bar{s}_{t-2} + \Delta\bar{s}_{t-3})/4$

B.7 Balance of Payments

Balance of payment identity:
$0 = ca_t^{rat} + fa_t^{rat}$

Balance of payment identity (trend):
$0 = \overline{ca}_t^{rat} + \overline{fa}_t^{rat}$

Current account:

$ca_t^{rat} = nx_t^{rat} + remit_t^{rat} - intcost_t^{f,rat} + oth_t^{rat}$

Current account trend:

$\overline{ca}_t^{rat} = \overline{nx}_t^{rat} + \overline{remit}_t^{rat} - \overline{intcost}_t^{f,rat} + \overline{oth}_t^{rat}$

Current account gap:

$\widehat{ca}_t^{rat} = ca_t^{rat} - \overline{ca}_t^{rat}$

Net-export:

$nx_t^{rat} = x_t^{rat} - m_t^{rat}$

Net-export trend:

$\overline{nx}_t^{rat} = \bar{x}_t^{rat} - \bar{m}_t^{rat}$

Net-export gap:

$\widehat{nx}_t^{rat} = nx_t^{rat} - \overline{nx}_t^{rat}$

Total remittances:

$remit_t^{rat} = \overline{remit}_t^{rat} + \widehat{remit}_t^{rat}$

Remittances trend:

$\overline{remit}_t^{rat} = \rho^{\overline{remit}^{rat}} \overline{remit}_{t-1}^{rat} + \left(1 - \rho^{\overline{remit}^{rat}}\right) remit^{rat,ss} + \varepsilon_t^{\overline{remit}^{rat}}$

Remittances gap:

$\widehat{remit}_t^{rat} = \rho^{\widehat{remit}^{rat}} \widehat{remit}_{t-1}^{rat} + \left(1 - \rho^{\widehat{remit}^{rat}}\right) g_1 \hat{y}_t^{w} + \varepsilon_t^{\widehat{remit}^{rat}}$

Other foreign net income:

$oth_t^{rat} = \overline{oth}_t^{rat} + \widehat{oth}_t^{rat}$

Other foreign net income trend:

$\overline{oth}_t^{rat} = \rho^{\overline{oth}^{rat}} \overline{oth}_{t-1}^{rat} + \left(1 - \rho^{\overline{oth}^{rat}}\right) oth^{rat,ss} + \varepsilon_t^{\overline{oth}^{rat}}$

Other foreign net income gap:

$\widehat{oth}_t^{rat} = \rho^{\widehat{oth}^{rat}} \widehat{oth}_{t-1}^{rat} + \varepsilon_t^{\widehat{oth}^{rat}}$

Financial account gap:

$\widehat{fa}_t^{rat} = fa_t^{rat} - \overline{fa}_t^{rat}$

Private sector net foreign financing position:

$$fa_t^{rat} = nfp_t^{rat} - fxi_t^{rat} - fxa_t^{rat} + debt1Y_t^{f,rat} - debt1Y_{t-4}^{f,rat} * \frac{\exp\left(\frac{\Delta^4 s_t}{100}\right)}{\exp\left(\frac{\Delta^4 gdp_t^{nom}}{100}\right)}$$

Private sector net foreign financing position trend:

$$\overline{fa}_t^{rat} = \overline{nfp}_t^{rat} - \overline{fxa}_t^{rat} + debt1Y_t^{f,rat,TAR} - debt1Y_{t-4}^{f,rat,TAR} * \frac{\exp\left(\frac{\Delta^4 \bar{s}_t}{100}\right)}{\exp\left(\frac{\Delta^4 \overline{gdp}_t^{nom}}{100}\right)}$$

Foreign credit supply, gap:

$$\widehat{nfp}_t^{rat} = h_1 \cdot \left(1 - \tau_t^{CFM,Admin}\right) \cdot \left(\widehat{prem}_t - \left(\tau_t^{CFM,flow} - \tau^{CFM,flow,SS}\right) - \varepsilon_t^{\widehat{prem}}\right)$$

Foreign credit supply, trend:

$$\overline{nfp}_t^{rat} = nfp^{SS} + \frac{h_2 \cdot \left(1 - \tau_t^{CFM,Admin}\right)}{1 - h_3} \cdot \left(\overline{prem}_t - h_3 \overline{prem}_{t-1} - (1 - h_3) prem^{SS} - \varepsilon_t^{\overline{prem}}\right)$$

B.8 Monetary Policy

Taylor-rule:

$$i_t^{pol} = \gamma_1 i_{t-1}^{pol} + (1 - \gamma_1)(\bar{r}_t + E_t \Delta cpi_{t+1}^{TAR} + \gamma_2 (E_t \Delta^4 cpi_{t+2} - E_t \Delta cpi_{t+2}^{TAR}) + \gamma_3 \hat{y}_t) + \varepsilon_t^{i^{pol}}$$

Market rate:

$$i_t^M = \gamma_4 i_{t-1}^M + (1 - \gamma_4) i_t^{pol} + \varepsilon_t^{i^M}$$

UIP condition:

$$i_t^M = i_t^{US} + prem_t + \xi \cdot fxi_t^{rat} + 4 \cdot (s_t^e - s_t) + \varepsilon_t^s$$

Nominal exchange rate expectation

$$s_t^e = \mu E_t s_{t+1} + (1 - \mu)[s_{t-1} + 1/2 \cdot \Delta \bar{s}_t]$$

Country risk premium:

$$prem_t = \overline{prem}_t + \widehat{prem}_t$$

FXI-rule:

$$fxi_t^{rat} = \gamma_5 fxi_{t-1}^{rat} + (1 - \gamma_5)\left(\gamma_6 \widehat{ca}_t^{rat} - \gamma_7 \widehat{fxres}_t^{ratimp}\right) - \gamma_8 \widehat{prem}_t - \gamma_9 \widehat{re}_t + \varepsilon_t^{fxi^{rat}}$$

FXA-rule:

$$fxa_t^{rat} = \gamma_{10} fxa_{t-1}^{rat} + (1 - \gamma_{10})\left(\overline{fxa}_t^{rat} - \gamma_{11} \widehat{fxres}_t^{ratimp}\right) + \varepsilon_t^{fxa^{rat}}$$

FX-reserve target:

$$\overline{fxres}_t^{ratimp} = \rho^{\overline{fxres}^{ratimp}} \overline{fxres}_{t-1}^{ratimp} + \left(1 - \rho^{\overline{fxres}^{ratimp}}\right) fxres^{ratimp,ss} + \varepsilon_t^{\overline{fxres}^{ratimp}}$$

FX-reserve accumulation:

$$fxres_t^{rat} = fxi_t^{rat} + fxa_t^{rat} + \left(1 + \frac{i_{t-1}^{us}}{400}\right) fxres_{t-1}^{rat} \left(1 + \frac{\Delta s_t}{400}\right) / \left(1 + \frac{\Delta gdp_t^{nom}}{400}\right)$$

FX-reserve gap:

$$\widehat{fxres}_t^{ratimp} = \gamma_{13}\left(fxres_t^{ratimp} - \overline{fxres}_t^{ratimp}\right) + (1 - \gamma_{13}) \widehat{fxres}_{t+1}^{ratimp}$$

FX-reserve consistent accumulation trend:

$$\overline{fxres}_t^{rat} = \overline{fxa}_t^{rat} + \left(1 + \frac{\bar{\iota}_{t-1}^{US}}{400}\right)\overline{fxres}_{t-1}^{rat}\left(1 + \frac{\Delta\bar{s}_t}{400}\right) / \left(1 + \frac{\Delta\overline{gdp}_{t-1}^{nom}}{400}\right)$$

Q-o-Q changes of nominal exchange rate:

$$\Delta s_t = (s_t - s_{t-1}) \text{ x } 4$$

Y-o-Y changes of nominal exchange rate:

$$\Delta^4 s_t = s_t - s_{t-4}$$

FX-reserve in months (Adequacy ratio):

$$fxres_t^{ratimp} = 3 \cdot \frac{fxres_t^{rat}}{m_t^{rat}}$$

FX-reserve trend in months (Adequacy ratio trend):

$$\overline{fxres}_t^{ratimp} = 3 \cdot \frac{\overline{fxres}_t^{rat}}{\overline{m}_t^{rat}}$$

Administrative CFM:

$$\tau_t^{CFM,Admin} = \rho^{\tau^{CFM,Admin}} \tau_{t-1}^{CFM,Admin} + (1 - \rho^{\tau^{CFM,Admin}})\tau^{CFM,Admin,ss} + \varepsilon_t^{CFM,Admin}$$

Price-based CFM:

$$\tau_t^{CFM,Flow} = \rho^{\tau^{CFM,Flow}} \tau_{t-1}^{CFM,Flow} + (1 - \rho^{\tau^{CFM,Flow}})\tau^{CFM,Flow,ss} + \varepsilon_t^{CFM,Flow}$$

B.9 Fiscal Policy

B.9.1 Government Expenditures

Total expenditures without debt service:

$$ex_t^{rat} = g_t^{rat} + gi_t^{rat} + tr_t^{rat}$$

Sum of central and local government current expenditures:

$$gc_t^{rat} = g_t^{rat} + of_t^{rat}$$

Local government current expenditures:

$$of_t^{rat} = \rho^{of^{rat}} of_{t-1}^{rat} + \left(1 - \rho^{of^{rat}}\right) of^{rat,SS} + \varepsilon_t^{of^{rat}}$$

Government capital expenditures:

$$gi_t^{i,rat} = \rho^{gi^{rat}} gi_{t-1}^{rat} + \left(1 - \rho^{gi^{rat}}\right) gi^{rat,SS} + \varepsilon_t^{gi^{rat}}$$

Government financial transfers:

$$tr_t^{rat} = \rho^{tr^{rat}} tr_{t-1}^{rat} + \left(1 - \rho^{tr^{rat}}\right) tr^{rat,SS} + \varepsilon_t^{tr^{rat}}$$

Total expenditures without debt service in trend:
$$\overline{ex}_t^{rat} = \bar{g}_t^{rat} + \bar{g\imath}_t^{rat} + \bar{tr}_t^{rat}$$

Sum of central and local government current expenditures in trend:
$$\overline{gc}_t^{rat} = \bar{g}_t^{rat} + \overline{of}_t^{rat}$$

Local government current expenditures trend:
$$\overline{of}_t^{rat} = (of_t^{rat} + of_{t-1}^{rat} + of_{t-2}^{rat} + of_{t-3}^{rat})/4$$

Government capital expenditures trend:
$$\bar{g\imath}_t^{rat} = (gi_t^{rat} + gi_{t-1}^{rat} + gi_{t-2}^{rat} + gi_{t-3}^{rat})/4$$

Government financial transfers trend:
$$\bar{tr}_t^{rat} = (tr_t^{rat} + tr_{t-1}^{rat} + tr_{t-2}^{rat} + tr_{t-3}^{rat})/4$$

Expenditure gaps:
$$\widehat{ex}_t^{rat} = ex_t^{rat} - \overline{ex}_t^{rat}$$
$$\hat{g}_t^{rat} = g_t^{rat} - \bar{g}_t^{rat}$$
$$\widehat{g\imath}_t^{rat} = gi_t^{rat} - \bar{g\imath}_t^{rat}$$
$$\widehat{tr}_t^{rat} = tr_t^{rat} - \bar{tr}_t^{rat}$$
$$\widehat{of}_t^{rat} = of_t^{rat} - \overline{of}_t^{rat}$$

Total debt service:
$$intcost_t^{rat} = intcost_t^{d,rat} + intcost_t^{f,rat}$$

LCY debt service:
$$intcost_t^{d,rat} = \frac{\left(\exp\left(\frac{i4_{t-1}^d}{400}\right)-1\right)debt1Y_{t-1}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-2}^d}{400}\right)-1\right)debt1Y_{t-2}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-3}^d}{400}\right)-1\right)debt1Y_{t-3}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}+\frac{\Delta gdp_{t-2}^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-4}^d}{400}\right)-1\right)debt1Y_{t-4}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}+\frac{\Delta gdp_{t-2}^{nom}}{400}+\frac{\Delta gdp_{t-3}^{nom}}{400}\right)}$$

1Y LCY interest rate:
$$i4_t^d = (1-w^c)\left(\frac{i_t + i_{t+1} + i_{t+2} + i_{t+3}}{4} + tprem_t^d\right) + w^c(\bar{\imath}_t + tprem^{d,ss})$$

1Y LCY term premium:
$$tprem_t^d = \rho^{tprem^d} tprem_{t-1}^d + \left(1-\rho^{tprem^d}\right)tprem^{d,ss} + g_2\left(debt_t^{d,rat} - debt^{d,rat,ss}\right) + \varepsilon_t^{tprem^{dom}}$$

1Y FCY debt service:

$$intcost_t^{f,rat} = \frac{\left(\exp\left(\frac{i4_{t-1}^*}{400}\right)-1\right)\exp\left(\frac{\Delta s_t}{400}\right) debt1Y_{t-1}^{f,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}\right)} +$$

$$\dots \frac{\left(\exp\left(\frac{i4_{t-2}^*}{400}\right)-1\right)\exp\left(\frac{\Delta s_t+\Delta s_{t-1}}{400}\right) debt1Y_{t-2}^{f,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-3}^*}{400}\right)-1\right)\exp\left(\frac{\Delta s_t+\Delta s_{t-1}+\Delta s_{t-2}}{400}\right) debt1Y_{t-3}^{f,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}+\frac{\Delta gdp_{t-2}^{nom}}{400}\right)} +$$

$$\dots \frac{\left(\exp\left(\frac{i4_{t-4}^*}{400}\right)-1\right)\exp\left(\frac{\Delta s_t+\Delta s_{t-1}+\Delta s_{t-2}+\Delta s_{t-3}}{400}\right) debt1Y_{t-4}^{f,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}+\frac{\Delta gdp_{t-1}^{nom}}{400}+\frac{\Delta gdp_{t-2}^{nom}}{400}+\frac{\Delta gdp_{t-3}^{nom}}{400}\right)}$$

1Y FCY interest rate:

$$i4_t^* = (1-w^c)\left(\frac{i_t^{us}+i_{t+1}^{us}+i_{t+2}^{us}+i_{t+3}^{us}}{4} + \frac{prem_t+prem_{t+1}+prem_{t+2}+prem_{t+3}}{4} + tprem_t^*\right) + w^c(\bar{\iota}_t^{US} + \overline{prem}_t + tprem^{*,ss})$$

1Y FCY term premium:

$$tprem_t^* = \rho^{tprem^*} tprem_{t-1}^* + \left(1-\rho^{tprem^*}\right) tprem^{*,ss} + g_3\left(debt_t^{f,rat} - debt^{f,rat,ss}\right) + \varepsilon_t^{tprem^*}$$

B.9.2 Government Revenues

Total revenues from the primary deficit

$$primdef_t^{rat} = ex_t^{rat} - rev_t^{rat}$$

Total revenues from the structural deficit

$$\overline{rev}_t^{rat} = (rev_t^{rat} + rev_{t-1}^{rat} + rev_{t-2}^{rat} + rev_{t-3}^{rat})/4$$

Total revenue gap:

$$\widehat{rev}_t^{rat} = rev_t^{rat} - \overline{rev}_t^{rat}$$

Total revenue trend:

$$\overline{rev}_t^{rat} = (rev_t^{rat} + rev_{t-1}^{rat} + rev_{t-2}^{rat} + rev_{t-3}^{rat})/4$$

B.9.3 Debt Accumulation

Total public debt:

$$debt_t^{rat} = debt_t^{d,rat} + debt_t^{f,rat}$$

Total 1Y LCY debt:

$$debt_t^{d,rat} = debt1Y_t^{d,rat} + \frac{debt1Y_{t-1}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}\right)} + \frac{debt1Y_{t-2}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}+\Delta gdp_{t-1}^{nom}}{400}\right)} + \cdots$$

$$\dots \frac{debt1Y_{t-3}^{d,rat}}{\exp\left(\frac{\Delta gdp_t^{nom}+\Delta gdp_{t-1}^{nom}+\Delta gdp_{t-2}^{nom}}{400}\right)}$$

Total 1Y FCY debt:

$$debt_t^{f,rat} = debt1Y_t^{f,rat} + \frac{debt1Y_{t-1}^{f,rat}\exp\left(\frac{\Delta s_t}{400}\right)}{\exp\left(\frac{\Delta gdp_t^{nom}}{400}\right)} + \frac{debt1Y_{t-2}^{f,rat}\exp\left(\frac{\Delta s_t + \Delta s_{t-1}}{400}\right)}{\exp\left(\frac{\Delta gdp_t^{nom} + \Delta gdp_{t-1}^{nom}}{400}\right)} + \cdots$$

$$\cdots \frac{debt1Y_{t-3}^{f,rat}\exp\left(\frac{\Delta s_t + \Delta s_{t-1} + \Delta s_{t-2}}{400}\right)}{\exp\left(\frac{\Delta gdp_t^{nom} + \Delta gdp_{t-1}^{nom} + \Delta gdp_{t-2}^{nom}}{400}\right)}$$

1Y LCY new debt issuance:

$$debt1Y_t^{d,rat} = \theta_t \cdot def_t^{rat} + \frac{debt1Y_{t-4}^{d,rat}}{\exp\left(\frac{\Delta^4 gdp_t^{nom}}{100}\right)} + \varepsilon_t^{debt1Y^{d,rat}}$$

1Y FCY new debt issuance:

$$debt1Y_t^{f,rat} = (1-\theta_t) \cdot def_t^{rat} + \frac{debt1Y_{t-4}^{f,rat}\exp\left(\frac{\Delta^4 s_t}{100}\right)}{\exp\left(\frac{\Delta^4 gdp_t^{nom}}{100}\right)} + \varepsilon_t^{debt1Y^{f,rat}}$$

B.9.4 Fiscal Anchor, Deficits and Reaction Functions

Government deficit:

$$def_t^{rat} = primdef_t^{rat} + intcost_t^{rat} + \varepsilon_t^{def^{rat}}$$

Primary deficit:

$$primdef_t^{rat} = defstruct_t^{rat} + defcycle_t^{rat}$$

Primary deficit (cyclical):

$$defcycle_t^{rat} = -f_1\hat{y}_t + \varepsilon_t^{defcycle^{rat}}$$

Cyclically adjusted primary deficit:

$$defstruct_t^{rat} = \rho_{fp}(defstruct_{t-1}^{rat} - f_2\hat{y}_t) + (1-\rho_{fp})\left(defstruct_t^{rat,TAR} - f_3\widehat{debt}_t^{rat}\right) + \varepsilon_t^{defstruct^{rat}}$$

Debt deviation:

$$\widehat{debt}_t^{rat} = f_4\left(debt_t^{rat} - debt_t^{rat,TAR}\right) + (1-f_4)E_t\widehat{debt}_{t+1}^{rat}$$

Share of LCY financing:

$$\theta_t = \rho^\theta\theta_{t-1} + \left(1-\rho^\theta\right)\theta^{ss} + \varepsilon_t^\theta$$

B.9.5 Fiscal Targets

Public debt target:

$$debt_t^{rat,TAR} = \rho^{debt^{rat,TAR}} debt_{t-1}^{rat,TAR} + \left(1-\rho^{debt^{rat,TAR}}\right)debt^{rat,SS} + \varepsilon_t^{debt^{rat,TAR}}$$

Total public debt target:

$$debt_t^{rat,TAR} = debt_t^{d,rat,TAR} + debt_t^{f,rat,TAR}$$

LCY public debt target:

$$debt_t^{d,rat,TAR} = debt1Y_t^{d,rat,TAR} + \frac{debt1Y_{t-1}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}}{400}\right)} + \frac{debt1Y_{t-2}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom}}{400}\right)} + \cdots$$

$$\ldots \frac{debt1Y_{t-3}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom} + \Delta\overline{gdp}_{t-2}^{nom}}{400}\right)}$$

FCY public debt target:

$$debt_t^{f,rat,TAR} = debt1Y_t^{f,rat,TAR} + \frac{debt1Y_{t-1}^{f,rat,TAR}\exp\left(\frac{\Delta\bar{s}_t}{400}\right)}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}}{400}\right)} + \frac{debt1Y_{t-2}^{f,rat,TAR}\exp\left(\frac{\Delta\bar{s}_t + \Delta\bar{s}_{t-1}}{400}\right)}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom}}{400}\right)} + \cdots$$

$$\ldots \frac{debt1Y_{t-3}^{f,rat,TAR}\exp\left(\frac{\Delta\bar{s}_t + \Delta\bar{s}_{t-1} + \Delta\bar{s}_{t-2}}{400}\right)}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom} + \Delta\overline{gdp}_{t-2}^{nom}}{400}\right)}$$

LCY targeted new issuance:

$$debt1Y_t^{d,rat,TAR} = \theta_t \cdot def_t^{rat,TAR} + \frac{debt1Y_{t-4}^{d,rat,TAR}}{\exp\left(\frac{\Delta^4\overline{gdp}_t^{nom}}{100}\right)}$$

FCY targeted new issuance:

$$debt1Y_t^{f,rat,TAR} = (1-\theta_t) \cdot def_t^{rat,TAR} + \frac{debt1Y_{t-4}^{f,rat,TAR}\exp\left(\frac{\Delta^4\bar{s}_t}{100}\right)}{\exp\left(\frac{\Delta^4\overline{gdp}_t^{nom}}{100}\right)}$$

Targeted total debt service:

$$intcost_t^{rat,TAR} = intcost_t^{d,rat,TAR} + intcost_t^{f,rat,TAR}$$

LCY targeted debt service:

$$intcost_t^{d,rat,TAR} = \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^d}{400}\right) - 1\right) debt1Y_{t-1}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^d}{400}\right) - 1\right) debt1Y_{t-2}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^d}{400}\right) - 1\right) debt1Y_{t-3}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom} + \Delta\overline{gdp}_{t-2}^{nom}}{400}\right)} +$$

$$\frac{\left(\exp\left(\frac{\overline{\imath 4}_t^d}{400}\right) - 1\right) debt1Y_{t-4}^{d,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom} + \Delta\overline{gdp}_{t-1}^{nom} + \Delta\overline{gdp}_{t-2}^{nom} + \Delta\overline{gdp}_{t-3}^{nom}}{400}\right)}$$

LCY long term interest rate:

$$\overline{\imath 4}_t^d = \bar{\imath}_t + tprem^{d,ss}$$

FCY targeted debt service:

$$intcost_t^{f,rat,TAR} = \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^*}{400}\right)-1\right)\exp\left(\frac{\Delta\bar{s}_t}{400}\right) debt1Y_{t-1}^{f,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}}{400}\right)} +$$

$$\dots \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^*}{400}\right)-1\right)\exp\left(\frac{\Delta\bar{s}_t+\Delta\bar{s}_{t-1}}{400}\right) debt1Y_{t-2}^{f,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}+\Delta\overline{gdp}_{t-1}^{nom}}{400}\right)} + \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^*}{400}\right)-1\right)\exp\left(\frac{\Delta\bar{s}_t+\Delta\bar{s}_{t-1}+\Delta\bar{s}_{t-2}}{400}\right) debt1Y_{t-3}^{f,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}+\Delta\overline{gdp}_{t-1}^{nom}+\Delta\overline{gdp}_{t-2}^{nom}}{400}\right)} +$$

$$\dots \frac{\left(\exp\left(\frac{\overline{\imath 4}_t^*}{400}\right)-1\right)\exp\left(\frac{\Delta\bar{s}_t+\Delta\bar{s}_{t-1}+\Delta\bar{s}_{t-2}+\Delta\bar{s}_{t-3}}{400}\right) debt1Y_{t-4}^{f,rat,TAR}}{\exp\left(\frac{\Delta\overline{gdp}_t^{nom}+\Delta\overline{gdp}_{t-1}^{nom}+\Delta\overline{gdp}_{t-2}^{nom}+\Delta\overline{gdp}_{t-3}^{nom}}{400}\right)}$$

FCY long term interest rate:

$$\overline{\imath 4}_t^* = \bar{\imath}_t^{US} + prem^{ss} + tprem^{*,ss}$$

Primary deficit target:

$$def_t^{rat,TAR} = defstruct_t^{rat,TAR} + intcost_t^{rat,TAR}$$

B.10 Foreign Variables

Relative price of oil:

$$rpc_t^{oil} = pc_t^{oil} - cpi_t^{US}$$

$$rpc_t^{oil} = \widehat{rpc}_t^{oil} + \overline{rpc}_t^{oil}$$

$$\Delta\overline{rpc}_t^{oil} = \rho^{\Delta\overline{rpc}^{oil}}\Delta\overline{rpc}_{t-1}^{oil} + \left(1-\rho^{\Delta\overline{rpc}^{oil}}\right)\Delta rpc^{oil,ss} + \varepsilon_t^{\Delta\overline{rpc}^{oil}}$$

$$\Delta\overline{rpc}_t^{oil} = (\overline{rpc}_t^{oil} - \overline{rpc}_{t-1}^{oil}) \text{ x } 4$$

$$\widehat{rpc}_t^{oil} = \rho^{\widehat{rpc}^{oil}}\widehat{rpc}_{t-1}^{oil} + \varepsilon_t^{\widehat{rpc}^{oil}}$$

Relative price of food:

$$rpc_t^{food} = pc_t^{food} - cpi_t^{US}$$

$$rpc_t^{food} = \widehat{rpc}_t^{food} + \overline{rpc}_t^{food}$$

$$\Delta\overline{rpc}_t^{food} = \rho^{\Delta\overline{rpc}^{food}}\Delta\overline{rpc}_{t-1}^{food} + \left(1-\rho^{\Delta\overline{rpc}^{food}}\right)\Delta rpc^{food,ss} + \varepsilon_t^{\Delta\overline{rpc}^{food}}$$

$$\Delta\overline{rpc}_t^{food} = (\overline{rpc}_t^{food} - \overline{rpc}_{t-1}^{food}) \text{ x } 4$$

$$\widehat{rpc}_t^{food} = \rho^{\widehat{rpc}^{food}}\widehat{rpc}_{t-1}^{food} + \varepsilon_t^{\widehat{rpc}^{food}}$$

US CPI Phillips curve:

$$\Delta cpi_t^{US} = k_1\Delta cpi_{t-1}^{US} + (1-k_1)\Delta cpi^{US,ss} + \varepsilon_t^{\Delta cpi^{US}}$$

Q-o-Q US CPI:

$$\Delta cpi_t^{US} = (cpi_t^{US} - cpi_{t-1}^{US}) \text{ x } 4$$

Y-o-Y US CPI:

$$\Delta^4 cpi_t^{US} = (cpi_t^{US} - cpi_{t-4}^{US})$$

US FED policy rate:

$$i_t^{US} = k_2 i_{t-1}^{US} + (1-k_2)(\bar{r}_t^{US} + \Delta cpi^{US,ss}) + \varepsilon_t^{i^{US}}$$

US real interest rate:
$r_t^{US} = i_t^{US} - E_t \Delta cpi_{t+1}^{US}$

US GDP gap:
$\hat{y}_t^{US} = k_3 \hat{y}_{t-1}^{US} + \varepsilon_t^{\hat{y}^{US}}$

US real interest rate gap:
$r_t^{US} = \hat{r}_t^{US} + \bar{r}_t^{US}$

US real interest rate trend:
$\bar{r}_t^{US} = \rho^{\bar{r}^{US}} \bar{r}_t^{US} + \left(1 - \rho^{\bar{r}^{US}}\right) r^{US,ss} + \varepsilon_t^{\bar{r}^{US}}$

Other trading partners output gap, exchange rate, inflation and real exchange rate $j = \{EZ, CN, JP, RC\}$
$\hat{y}_t^j = \rho^{\hat{y}^j} \hat{y}_{t-1}^j + \varepsilon_t^{\hat{y}^j}$
$\Delta cpi_t^j = \rho^{\Delta cpi^j} \Delta cpi_{t-1}^j + \left(1 - \rho^{\Delta cpi^j}\right) \Delta cpi^{j,ss} + \varepsilon_t^{\Delta cpi^j}$
$\widehat{re}_t^j = \rho^{\widehat{re}^j} \widehat{re}_{t-1}^j + \varepsilon_t^{\widehat{re}^j}$
$\Delta cpi_t^j = (cpi_t^j - cpi_{t-1}^j)$ x 4
$\Delta s_t^j = \rho^{\Delta s^j} \Delta s_{t-1}^j + \left(1 - \rho^{\Delta s^j}\right)(\Delta cpi^{j,ss} - \Delta cpi^{US,ss} + \Delta re^{j,ss}) + \varepsilon_t^{\Delta s^j}$
$\Delta \overline{re}_t^j = \rho^{\Delta \overline{re}^j} \Delta \overline{re}_t^j + \left(1 - \rho^{\Delta \overline{re}^j}\right) \Delta re^{j,ss} + \varepsilon_t^{\Delta \overline{re}^j}$

Effective foreign demand gap:

$$\hat{y}_t^w = \sum_{US,EZ,CN,JP,RC} w^{\hat{y}^j} \hat{y}_t^j$$

Appendix C: Parameters

Real Aggregate Demand			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
		Cyclical variables	
a_1	0.5	Consumption gap lag term	Iterative adjustment
a_2	0.2	Consumption gap forward looking term	Iterative adjustment
a_3	0.12	Elasticity of the consumption gap wrt monetary conditions	Iterative adjustment
a_4	0.25	Weight of real lending rate gap in monetary conditions	Iterative adjustment
a_5	0.1	Additional effect of country risk premium on domestic financing conditions	Iterative adjustment
a_6	0.15	Elasticity of the consumption gap wrt income	Iterative adjustment
a_7	0.1	Weight of trems-of-trade in consumption gap	Iterative adjustment
a_8	0.05	Elasticity of the consumption gap wrt the remittances	Iterative adjustment
a_9	0.05	Elasticity of the consumption gap wrt government taxation	Iterative adjustment
a_{10}	0.08	Elasticity of the consumption gap wrt real wage gaps	Iterative adjustment
a_{11}	0.05	Elasticity of the consumption gap wrt credit shock	Iterative adjustment
a_{12}	0.36	Investment gap lag term	Iterative adjustment
a_{13}	0.2	Investment gap forward looking term	Iterative adjustment
a_{14}	0.2	Elasticity of the investment gap wrt Tobin-Q	Iterative adjustment
a_{15}	0	Elasticity of the investment gap wrt relative price investment	Iterative adjustment
a_{16}	0.5	Elasticity of the investment gap wrt government investment	Iterative adjustment
a_{17}	0	Elasticity of the investment gap wrt credit shock	Iterative adjustment
a_{18}	0.2	Elasticity of the Tobin-Q wrt expected income	Iterative adjustment
a_{19}	0.5	Elasticity of the Tobin-Q wrt expected asset price	Iterative adjustment
a_{20}	0.2	Elasticity of the Tobin-Q wrt monetary conditions	Iterative adjustment

a_{21}	0.5	Weight of real interest rate gap in monetary conditions	Iterative adjustment
a_{22}	0.3	Weight of real credit rate gap in monetary conditions	Iterative adjustment
a_{23}	0.5	Tobin-Q forward looking term	Iterative adjustment
a_{24}	0.5	Gov. Consumption gap lag term	Iterative adjustment
a_{25}	0.6	Export gap lag term	Iterative adjustment
a_{26}	0.025	Elasticity of the export gap wrt real effective ex. rate	Iterative adjustment
a_{27}	0.5	Elasticity of the export gap wrt export price	Iterative adjustment
a_{28}	1.5	Elasticity of the export gap wrt foreign demand	Iterative adjustment
a_{29}	0.4	Import gap lag term	I/O tables
a_{30}	0.36	Weight of consumption gap in import	Iterative adjustment
a_{31}	0.025	Price elasticity of the import gap wrt real exchange rate	I/O tables
a_{32}	0.06	Weight of gov. consumption gap in import	I/O tables
a_{33}	0.27	Weight of investment gap in import	I/O tables
Trend variables			
$\rho^{\Delta\bar{y}}$	0.9	Potential growth persistence	Iterative adjustment
$\rho^{\Delta\bar{c}}$	0.5	Consumption trend persistence	Iterative adjustment
$\delta^{\Delta\bar{c}}$	0.25	Consumption trend error-correction term	Iterative adjustment
$\rho^{\Delta\overline{inv}}$	0.5	Investment trend persistence	Iterative adjustment
$\delta^{\Delta\overline{inv}}$	0.6	Investment trend error-correction term	Iterative adjustment
$\rho^{\Delta\overline{gc}}$	0.5	Gov. consumption trend persistence	Iterative adjustment
$\delta^{\Delta\overline{gc}}$	0.6	Gov. consumption trend error-correction term	Iterative adjustment
$\rho^{\Delta\bar{x}}$	0.8	Export trend persistence	Iterative adjustment
$\delta^{\Delta\bar{x}}$	0.1	Export trend error-correction term	Iterative adjustment
Steady-state ratios			
Δy^{ss}	5.8269	Steady-state potential GDP growth	Historical average
$c^{rat,ss}$	74	Consumption in terms of GDP	Historical average
$inv^{rat,ss}$	23	Investment in terms of GDP	Historical average
$gov^{rat,ss}$	10	Gov. consumption in terms of GDP	Historical average
$x^{rat,ss}$	27	Export in terms of GDP	Historical average

Labor Market			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
		Cyclical and trend variables	
σ_1	0.3	Nominal Business Wage lag term	Iterative adjustment
σ_2	0.05	Wage wrt Marginal Rate of Substitution	Iterative adjustment
σ_3	1	Weight of the consumption gap in Marginal Rate of Substitution	Iterative adjustment
σ_4	14	Weight of the real wage gap in Marginal Rate of Substitution	Iterative adjustment
σ_5	0.3	Elasticity of Nominal Business Wage wrt Minimum Wage Increase	Iterative adjustment
σ_6	0.2	Weight of Minimum Wage in Total Wage index	Historical average
σ_7	0.9	Real Wage Trend lag term	Iterative adjustment
σ_8	0.3	Elasticity of the real wage trend wrt potential growth	Iterative adjustment
σ_9	0.85	Unemployment gap lag term	Iterative adjustment
σ_{10}	0.3	Elasticity of the unemployment gap wrt output gap	Iterative adjustment
σ_{11}	0.9	Unemployment Trend lag term	Iterative adjustment
σ_{12}	0.2	Elasticity of the unemployment trend wrt potential growth	Iterative adjustment
		Steady-state ratios	
Δwr^{ss}	1.5	Steady-state real wage growth	Historical average
une^{ss}	6.5	Steady-state unemployment ratio	Historical average

Credit and Banking Sector			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
Cyclical variables			
δ^{h}	0.1	Duration of Households' Outstanding credit	Iterative adjustment
δ^{f}	0.15	Duration of Firms' Outstanding credit	Iterative adjustment
$\rho^{\widehat{ncr}^{h,rat}}$	0.25	Households' New credit gap lag term	Iterative adjustment
$\alpha^{\widehat{ncr}^{h,rat}}$	0.05	Elasticity of Hh. New Credit Gap wrt Consumption Gap	Iterative adjustment
$\beta^{\widehat{ncr}^{h,rat}}$	0.025	Elasticity of Hh. New Credit Gap wrt Real Credit Rate Gap	Iterative adjustment
$\rho^{\widehat{ncr}^{f,rat}}$	0.4	Firms' New credit gap lag term	Iterative adjustment
ltv	0.75	Loan to Value Ratio	Iterative adjustment
$\beta^{\widehat{ncr}^{f,rat}}$	0.2	Elasticity of Firms New Credit Gap wrt Real Credit Rate Gap	Iterative adjustment
$\rho^{rs^{L}}$	0.35	Credit Rate lag term	Iterative adjustment
λ^{HP}	1600	HP-filter coefficient	Iterative adjustment
ω^{HP}	0.8	Weight of HP trend	Iterative adjustment
$\rho^{prem^{cc}}$	0.5	Market risk premium lag term	Iterative adjustment
$\alpha_1^{prem^{cc}}$	0.1	Elasticity of Market risk premium wrt Output gap	Iterative adjustment
$\alpha_2^{prem^{cc}}$	0.25	Elasticity of Market risk premium wrt Country Risk Premium	Iterative adjustment
f_0	0.1	Elasticity of Borrower Default Risk wrt Bank Capital gap	Iterative adjustment
$\rho^{\widehat{zh}}$	0.5	Asset price lag term	Iterative adjustment
$\beta^{\widehat{zh}}$	0.95	Borrowers' discount factor	Iterative adjustment
$\alpha_1^{\widehat{zh}}$	0.2	Elasticity of Asset Price wrt Domestic demand	Iterative adjustment
$\alpha_2^{\widehat{zh}}$	0.5	Elasticity of Asset Price wrt Real Credit Rate	Iterative adjustment
Φ	0	Reaction to credit deviation from steady-state ratio	Iterative adjustment
$\rho^{\overline{ncr}^{h,rat}}$	0.92	Households' New Credit trend lag term	Iterative adjustment
$\rho^{\overline{ncr}^{f,rat}}$	0.9	Firms' New Credit trend lag term	Iterative adjustment
$\rho^{bc^{ta,tar}}$	0.75	Total Asset target lag term	Iterative adjustment

Steady-state ratios			
$bc^{ss,ta,tar}$	12	Targeted bank capital to asset ratio	Historical average
$cr^{ss,rat}$	45	Total Credit ratio	Historical average
rr	0	Reserve Requirement Ratio	Historical average
$div^{ta,ss}$	0	Dividend to Asset ratio	Historical average
$prem^{ss,cc}$	1.55	Market risk premium	Historical average
$s^{cr,f}$	0.9	Share of firms' credit in total credit	Historical average

Aggregate Supply			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
CPI: Core and Non-core Phillips-curves			
$w^{cpi,food}$	0.2137	Weight of food items in CPI	CPI database
$w^{cpi,energy}$	0.0819	Weight of energy items in CPI	CPI database
b_1	0.2	Core CPI lag term	Iterative adjustment
b_2	0.05	Elasticity of the core inflation wrt output gap	Iterative adjustment
b_3	0.01	Elasticity of the core inflation wrt real effective exchange rate	Iterative adjustment
b_4	0.005	Elasticity of the core inflation wrt domestic energy price	Iterative adjustment
b_5	0.005	Elasticity of the core inflation wrt domestic food price	Iterative adjustment
b_6	0.05	Elasticity of the core inflation wrt real wage	Iterative adjustment
b_7	0.25	Food CPI lag term	Iterative adjustment
b_8	0.066	Elasticity of the food inflation wrt international food prices	Iterative adjustment
b_9	0.25	Energy CPI lag term	Iterative adjustment
b_{10}	0.18	Elasticity of the food inflation wrt international oil prices	Iterative adjustment
$\rho^{\Delta\overline{rp}^{core}}$	0.75	Relative food price trend lag	Iterative adjustment
$\rho^{\Delta\overline{rp}^{food}}$	0.75	Relative core price trend lag	Iterative adjustment
Steady-state			
$\Delta\overline{rp}^{core,ss}$	0	Steady-state relative core price growth	Historical average
$\Delta\overline{rp}^{food,ss}$	0	Steady-state relative food price growth	Historical average

GDP Deflators			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
Phillips-curves and relative price trends			
d_1	0.25	Error correction term in consumption deflator equation	Iterative adjustment
d_2	0.4	Investment deflator lag term	Iterative adjustment
d_3	0.2	Elasticity of the investment deflator wrt real marginal cost	Iterative adjustment
d_4	0.2	Weight of investment gap in real marginal cost by investment deflator equation	Iterative adjustment
d_5	0.05	Weight of oil price gap in real marginal cost by investment deflator equation	Iterative adjustment
d_6	0.3	Gov. consumption deflator lag term	Iterative adjustment
d_7	0.3	Elasticity of the gov. consumption deflator wrt real marginal cost	Iterative adjustment
d_8	0.6	Weight of gov. cons. gap in real marginal cost by gov. cons. deflator equation	Iterative adjustment
d_9	0.05	Weight of oil price gap in real marginal cost by gov. cons. deflator equation	Iterative adjustment
d_{10}	0.3	Export deflator lag term	Iterative adjustment
d_{11}	0.4	Elasticity of the export deflator wrt real marginal cost	Iterative adjustment
d_{12}	0.6	Weight of export gap in real marginal cost by export deflator equation	Iterative adjustment
d_{13}	0.1	Weight of oil price gap in real marginal cost by export deflator equation	Iterative adjustment
d_{14}	0.3	Import deflator lag term	Iterative adjustment
d_{15}	0.4	Elasticity of the import deflator wrt real marginal cost	Iterative adjustment
d_{16}	0.4	Weight of import gap in real marginal cost by import deflator equation	Iterative adjustment
d_{17}	0.189	Weight of oil price gap in real marginal cost by import deflator equation	Iterative adjustment

d_{18}	0.1	Weight of food price gap in real marginal cost by import deflator equation	Iterative adjustment
$\rho^{\Delta\overline{rp}^{C,ss}}$	0.5	Relative consumption deflator price trend lag	Iterative adjustment
$\rho^{\Delta\overline{rp}^{Inv,ss}}$	0.75	Relative investment deflator price trend lag	Iterative adjustment
$\rho^{\Delta\overline{rp}^{Gc,ss}}$	0.75	Relative gov. consumption deflator price trend lag	Iterative adjustment
$\rho^{\Delta\overline{rp}^{X,ss}}$	0.9	Relative export deflator price trend lag	Iterative adjustment
$\rho^{\Delta\overline{rp}^{M,ss}}$	0.9	Relative import deflator price trend lag	Iterative adjustment
Steady-state			
$\Delta\overline{rp}^{C,ss}$	-0.5	Steady-state relative consumption deflator growth	Historical average
$\Delta\overline{rp}^{Inv,ss}$	-1	Steady-state relative investment deflator growth	Historical average
$\Delta\overline{rp}^{Gc,ss}$	0	Steady-state relative gov. consumption deflator growth	Historical average
$\Delta\overline{rp}^{X,ss}$	-1.25	Steady-state relative export deflator growth	Historical average
$\Delta\overline{rp}^{M,ss}$	-1	Steady-state relative import deflator growth	Historical average

Balance of Payments and Monetary conditions			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
θ	0.25	Weight of inflation expectations	Iterative adjustment
ξ	0.35	Effectiveness of FX-intervention on Nominal Exchange rate	Iterative adjustment
μ	0.85	Weight of nominal exchange rate expectations	Iterative adjustment
$\rho^{\Delta\overline{reer}}$	0.85	Real exchange rate trend lag	Iterative adjustment
$\rho^{\overline{remit}^{rat}}$	0.7	Remittances trend lag	Iterative adjustment
$\rho^{\widehat{remit}^{rat}}$	0.3	Remittances gap lag	Iterative adjustment
g_1	0.2	Elasticity of the remittances gap wrt foreign effective demand gap	Iterative adjustment
$\rho^{\overline{oth}^{rat}}$	0.9	Other income trend lag	Iterative adjustment
$\rho^{\widehat{oth}^{rat}}$	0.3	Other income trend gap	Iterative adjustment
h_1	10	Elasticity of the premium gap wrt private sector capital flow	Iterative adjustment
h_2	10	Elasticity of the premium trend wrt private sector capital flow	Iterative adjustment
h_3	0.9	Premium trend lag term	Iterative adjustment

Monetary policy			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
γ_1	0.85	Interest rate smoothing	Iterative adjustment
γ_2	1.5	Responsiveness of BSP to Inflation deviation	Iterative adjustment
γ_3	0.3	Responsiveness of BSP to Output gap	Iterative adjustment
γ_4	0.25	Market rate lag term	Iterative adjustment
γ_5	0.5	FXI-rule lag term	Iterative adjustment
γ_6	0	Elasticity of the FX-intervention wrt current account	Iterative adjustment
γ_7	0	Elasticity of the FX-intervention wrt reserve requirement	Iterative adjustment
γ_8	0	Elasticity of the FX-intervention wrt risk premium	Iterative adjustment
γ_9	0	Elasticity of the FX-intervention wrt real exchange rate gap	Iterative adjustment
γ_{10}	0.8	FXA-rule lag term	Iterative adjustment
γ_{11}	0.5	Elasticity of the FX-accumulation wrt reserve requirement	Iterative adjustment
γ_{12}	0.3	Forward-lookingness of FXA-rule	Iterative adjustment
$\rho^{\overline{fxres}^{ratimp}}$	0.9	FX-reserve target lag term	Iterative adjustment
$\rho^{\tau^{CFM,Admin}}$	0	Administrative CFM lag term	Iterative adjustment
$\rho^{\tau^{CFM,Flow}}$	0	Price based CFM lag term	Iterative adjustment
Steady-state			
$\Delta\overline{reer}^{ss}$	0	Steady-state relative real app.	Historical average
$\overline{remit}^{rat,ss}$	8.5	Steady-state remittances	Historical average
$\overline{oth}^{rat,ss}$	0	Steady-state other income	Historical average
$prem^{ss}$	1.25	Steady-state risk premium	Historical average
$fxres^{ratimp,ss}$	8	Steady-state FX reserve ratio (in month of imports)	Historical average
$\tau^{CFM,Admin,ss}$	0	Steady-state Administrative CFM	Historical average
$\tau^{CFM,Flow,ss}$	0	Steady-state Price-based CFM	Historical average

Fiscal policy			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
Primary balance			
$\rho^{of^{rat}}$	0.7	Other gov. expenditures lag term	Iterative adjustment
$\rho^{gi^{rat}}$	0.7	Government investment lag term	Iterative adjustment
$\rho^{tr^{rat}}$	0.7	Government transfer lag term	Iterative adjustment
Debt service			
w^{c}	0	Share of concessional financing	Iterative adjustment
$\rho^{tprem^{d}}$	0.7	LCY term-premium lag	Iterative adjustment
$\rho^{tprem^{*}}$	0.7	FCY term-premium lag	Iterative adjustment
g_2	0	Elasticity of the LCY term-premium wrt LCY indebtedness	Iterative adjustment
g_3	0	Elasticity of the FCY term-premium wrt FCY indebtedness	Iterative adjustment
Fiscal rule			
f_1	0.2	Elasticity of the primary deficit wrt output gap	Iterative adjustment
f_2	0.1	Elasticity of the fiscal reaction function wrt output gap	Iterative adjustment
f_3	0.3	Elasticity of the fiscal reaction function wrt debt deviation	Iterative adjustment
f_4	0.3	Weight of actual debt deviation in fiscal reaction function	Iterative adjustment
ρ^{fp}	0.8	Smoothing of fiscal reaction function	Iterative adjustment
ρ^{θ}	0.9	Share of LCY financing lag term	Iterative adjustment
Steady-state			
$of^{rat,ss}$	2	Steady-state other gov. expenditure	Historical average
$gi^{rat,ss}$	5	Steady-state government investment	Historical average
$tr^{rat,ss}$	2	Steady-state government transfer	Historical average
$debt^{rat,ss}$	55	Steady-state public debt target (annual GDP)	Historical average
$tprem^{d,ss}$	1	Steady-state LCY term-premium	Historical average
$tprem^{*,ss}$	1	Steady-state FCY term-premium	Historical average
θ^{ss}	0.7	Steady-state LCY financing	Historical average

Foreign variables			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
Commodity prices			
$\rho^{\Delta\overline{rpc}^{oil}}$	0.95	Real price of oil trend lag term	Iterative adjustment
$\rho^{\widehat{rpc}^{oil}}$	0.7	Real price of oil gap lag term	Iterative adjustment
$\rho^{\Delta\overline{rpc}^{food}}$	0.95	Real price of food trend lag term	Iterative adjustment
$\rho^{\widehat{rpc}^{food}}$	0.7	Real price of food gap lag term	Iterative adjustment
US block			
k_1	0.8	US CPI lag term	Iterative adjustment
k_2	0.8	US FED policy rate lag term	Iterative adjustment
k_3	0.9	US output gap lag term	Iterative adjustment
$\rho^{\bar{r}^{US}}$	0.99	US neutral rate lag term	Iterative adjustment
$w^{\hat{y}^{US}}$	0.125	Weight in Foreign Demand	Historical average
$w^{\widehat{re}^{US}}$	0.25	Weight in Effective Foreign CPI	Historical average
Steady-state			
$r^{US,ss}$	1	Steady-state US real interest rate	Historical average
$\Delta cpi^{US,TAR}$	2.4693	Steady-state US CPI target	Historical average
$\Delta\overline{rpc}^{oil,ss}$	0	Steady-state growth of real price of oil	Historical average
$\Delta\overline{rpc}^{food,ss}$	0	Steady-state growth of real price of food	Historical average

Other trading partners demand, cpi, bilateral nominal and real ex. rate			
Code	**Value**	**Country**	**Weight ($w^{\hat{y}^j}$ or $w^{\widehat{re}^j}$)**
Other foreign demand components lag term (Calibrated to GPMN forecast)			
$\rho^{\hat{y}^{EZ}}$	0.90	Eurozone	0.082
$\rho^{\hat{y}^{CN}}$	0.85	China	0.220
$\rho^{\hat{y}^{JP}}$	0.85	Japan	0.138
$\rho^{\hat{y}^{RC}}$	0.90	Rest of the world	0.435
Other bilateral real ex. rate gap components lag term (Calibrated to GPMN forecast)			
$\rho^{\widehat{re}^{EZ}}$	0.70	Eurozone	0.13
$\rho^{\widehat{re}^{CN}}$	0.90	China	0.17
$\rho^{\widehat{re}^{JP}}$	0.60	Japan	0.20
$\rho^{\widehat{re}^{RC}}$	0.60	Rest of the world	0.25
Other bilateral real ex. rate trend components lag term (Calibrated to GPMN forecast), Steady-state			
$\rho^{\Delta\overline{re}^{EZ}}$	0.95	Eurozone	0.00
$\rho^{\Delta\overline{re}^{CN}}$	0.95	China	-1.00
$\rho^{\Delta\overline{re}^{JP}}$	0.95	Japan	0.00
$\rho^{\Delta\overline{re}^{RC}}$	0.95	Rest of the world	0.00
Other bilateral nominal ex. rate components lag term (Calibrated to GPMN forecast)			
$\rho^{\Delta s^{EZ}}$	0.40	Eurozone	
$\rho^{\Delta s^{CN}}$	0.40	China	
$\rho^{\Delta s^{JP}}$	0.40	Japan	
$\rho^{\Delta s^{RC}}$	0.40	Rest of the world	
Other foreign CPI lag term (Calibrated to GPMN forecast), Steady-state			
$\rho^{\Delta cpi^{EZ}}$	0.80	Eurozone	2.00
$\rho^{\Delta cpi^{CN}}$	0.80	China	2.00
$\rho^{\Delta cpi^{JP}}$	0.70	Japan	0.00
$\rho^{\Delta cpi^{RC}}$	0.52	Rest of the world	3.00

PUBLICATIONS

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