INTERNATIONAL MONETARY FUND

Algeria Macroeconomic Projection Model (AMPM)

Mustapha Abderrahim, Riad Mansouri, Fatma Zohra Ouail,
Sara Abadi, Kenza Elkrim, Mohamed-Fariz Zidane,
Philippe Karam, Gyorgy Molnar, Karel Musil, Valeriu Nalban

2026
FEB

IMF Working Paper

Institute for Capacity Development

Algeria Macroeconomic Projection Model (AMPM)

Prepared by Mustapha Abderrahim, Riad Mansouri, Fatma Zohra Ouail, Sara Abadi, Kenza Elkrim, Mohamed-Fariz Zidane, Philippe Karam, Gyorgy Molnar, Karel Musil, Valeriu Nalban*

Authorized for distribution by Natan Epstein
February 2026

ABSTRACT: The paper describes QMPM, the Quarterly Projection Model for the Bank of Algeria that underpins the Bank's Forecasting and Policy Analysis System. The model is designed to capture the key features of the economy, including the importance of the hydrocarbon sector, sizable fiscal policy impacts, monetary-fiscal interactions, a monetary aggregate targeting policy framework, and a managed exchange rate regime. Model-based analytical exercises demonstrate that AMPM displays both theoretical consistency and a robust data fit, confirming its practicality for conducting real-time policy analysis, forecasts, and risk scenarios in support of the Bank of Algeria's policy processes.

Algeria Macroeconomic Projection Model (AMPM)

Prepared by Mustapha Abderrahim, Riad Mansouri, Fatma Zohra Ouail, Sara Abadi, Kenza Elkrim, Mohamed-Fariz Zidane, Philippe Karam, Gyorgy Molnar, Karel Musil, Valeriu Nalban[1]

Contents

1. Introduction

In its efforts to modernize the current monetary policy framework, Banque d'Algérie (BA) is in the process of establishing an analytical platform to support evidence-based and forward-looking policymaking. This paper documents the structure and properties of the BA's Quarterly Projection Model (QPM), dubbed AMPM, representing the main analytical tool within the BA's Forecasting and Policy Analysis System (FPAS) developed with IMF technical assistance. AMPM is tailored to accurately capture key features of the Algerian economy, including the importance of hydrocarbon exports (oil and gas), fiscal policy impact, monetary-fiscal interactions, monetary aggregate targeting policy framework prioritizing price stability (defined by an implicit core inflation target), managed floating exchange rate arrangement, and quasi-closed capital account.[1]

Developing AMPM involves translating the complex and intertwined aspects of the current monetary policy framework into an analytical model. The BA framework is characterized by multiple objectives, lack of single and consistent nominal anchor such as inflation or the exchange rate, occasional not fully systematic use of instruments, reaction functions, and exchange rate strategies, influenced by exogenous shocks. Weak policy transmission is a significant issue due to shallow financial markets, the prevalence of state-owned banks (SOBs), commodity dependence (primarily oil and gas[2]) and the dominance of terms of trade and shocks. Data availability limitations also pose challenges.[3]

Algeria's monetary policy framework also features a range of structural and operational intricacies. The 2023 Monetary and Banking Law (MBL)[4] specifies BA's objectives, with price stability as the central monetary policy goal (Article 35). De jure, BA implements a monetary aggregate targeting framework, relying on base money as the operating target. Monetary policy is conducted primarily through liquidity management operations, including required reserves, open market operations and bilateral absorptions, but also interest rates—including BA policy rate (*taux directeur*) and rates applicable to deposit and marginal lending facilities—and exchange rate management. Together, these tools help steer broad money supply—measured by the M2 aggregate—towards growth rate targets aligned with price stability, defined by an implicit core inflation rate.

Historically, however, the M2 growth targets have had an indicative value rather than being strict numerical objectives, evident in occasional large deviations of M2 growth from the target and significant fluctuations in interbank interest rates. This is also a reflection of multiple targets pursued by the BA during specific time periods, which besides M2 growth include setting the nominal exchange rate value such as to achieve real effective exchange rate equilibrium or using an implicit inflation target, defined currently as 4 percent core inflation. Therefore, in addition to liquidity management operations, BA instruments comprise interest rates and exchange rate management (see below). Overall, the framework seems to be characterized by multiple

---

[1] Following IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), a managed floating exchange rate arrangement is a regime where the exchange rate is predominantly market-determined, with no predetermined path or specific target for the exchange rate. However, the monetary authority actively intervenes in the foreign exchange market to influence the exchange rate level or limit excessive fluctuations. The 2023 AREAER states that Algeria's monetary policy framework is characterized as de jure money aggregate targeting and "managed floating" albeit, de facto the exchange rate arrangement is classified as crawl-like. As of 2021, the Chinn-Ito index, which measures de jure capital account openness, indicates that Algeria has maintained a consistently low and stable level of openness over the past 25 years; see Chinn and Ito (2008) and the corresponding data updates.

[2] As of 2023, Algeria is placed among top twenty oil exporters and top seven gas exporters globally.

[3] Section 2 presents the key stylized facts of the Algerian economy that informed the development of AMPM. For a recent assessment of Algerian economic developments and challenges to the conduct of monetary policy, see IMF (2024) and (2025a); for an overview of the monetary policy transmission in Algeria, see IMF (2025b).

[4] See *Loi n° 23-09 du 3 Dhou El Hidja 1444, correspondant au 21 juin 2023, portant Loi monétaire et bancaire*.

nominal anchors (including inflation and exchange rate) and guided by multiple objectives or indicators, including inflation trends, exchange rate movements, and overall liquidity conditions.

Monetary policy transmission is therefore adversely impacted by multiple objectives and other structural impediments. Key specificities of the Algerian banking system with important policy implications include (i) dominant role of SOBs, which account for over 85 percent of total assets and practice subsidized loan rates (*taux bonifiés*) and government guarantees; (ii) highly uneven distribution of liquidity, with the outstanding role of the SOB acting as the receiver of hydrocarbon export revenues; (iii) lack of meaningful competition among financial institutions; (iv) complex nexus between state-owned enterprises (SOEs), SOBs, and the government; and (v) excess liquidity. Together, these factors are contributing to weakening policy transmission and undermine the signaling role of the BA's policymaking. Moreover, during major shock episodes, BA extended special financial resources to support government policies.[5] More recently though, the new MBL limits Treasury overdrafts (Article 48) while also providing the necessary operational and organization tools to support the modernization of the monetary policy framework and enhance the role of interest rates; see IMF (2025a, 2025b).

The managed exchange rate regime is upheld by the BA's dominant FX supplier position, stemming from the mandatory conversion of commodity exporters' FX inflows into local currency. BA intervenes in the FX market by directly setting the exchange rate reference value available to banks, using a very narrow bid-ask margin, aiming to close the perceived real effective exchange rate (REER) misalignment in a gradual manner and avoid undue volatility. The targeted REER level is estimated using a specialized empirical framework based on key foreign and domestic variables, including oil prices and budget balance. BA may also consider the deviation of core inflation from the implicit target when setting the nominal exchange rate, given the priority of price stability. Capital account restrictions and limited private sector FX flows, along with the existing FX market arrangements, imply that FX reserves adjust endogenously to current account surpluses (accumulation) or deficits (decumulation).

In addition to the current BA policy framework, the economic environment modeled within AMPM is characterized by the decomposition of total GDP into extractive (mainly hydrocarbon) and non-extractive sectors. The extractive sector is heavily impacted by global energy (oil and gas) prices and is largely exogenous to domestic developments, while non-extractive sectors reflect the domestic business cycle position and demand-side inflationary pressures that policymakers—both monetary and fiscal—can influence through aggregate demand management measures. On the supply-side, the model distinguishes between core and non-core (fresh agricultural goods) prices, with central bank measures having more traction on core prices. The balance of payments block reflects key stylized facts: exports consist primarily of hydrocarbon goods and are driven by global energy prices, capital flows are relatively small given the quasi-closed capital account, and current account positions are counterbalanced by changes in official reserves, given the BA's dominant position as FX supplier.

In terms of economic policies, AMPM aligns with the de jure monetary aggregate targeting and managed exchange rate regime, alongside a countercyclically-acting fiscal authority.[6] The central bank's behavior is

---

[5] For example, a special refinancing program (*Programme Spécial de Refinancement*, PSR) was implemented to support post-pandemic recovery. PSR was a one-year program totaling about 8.3 percent of GDP, launched in 2021 to facilitate public banks' refinancing with the BA using government debt securities in exchange for long-term syndicated loans to state-owned enterprises purchased by the Treasury; see IMF (2023) for additional details.

[6] In BA's forecasting practice, fiscal deficit projections in the baseline scenario reflect the latest available Finance Law and medium-term budgetary framework.

modeled using two reaction functions—for M2 growth and for setting the nominal exchange rate reference value—adjusted to achieve multiple objectives as described above, with a priority on price stability, defined by an implicit core inflation target. Money supply considers expected deviation of core inflation from the implicit target, cyclical positions of output and real exchange rate, announced or implicit M2 growth targets, and the impact of not fully sterilized official reserves flows (consistent with historical data correlations). The relative weights of these determinants, captured by the magnitudes of the correspondent parameters, are assigned to emphasize price stability and the flexibility of M2 targets. The dinar exchange rate dynamics account for the observed rigidity and the BA's stabilization efforts, aiming to gradually align the dinar's price with its fundamental value while taking into account price stability. The fiscal policy block includes public domestic debt accumulation, decomposed into marketable and non-marketable components, and features a fiscal reaction function for the structural deficit to ensure debt sustainability and provide countercyclical support to economic activity.

The model is calibrated to provide both economically intuitive shock propagation mechanisms and a reasonable fit to Algerian data. These are key preconditions for ensuring AMPM is a relevant tool for regular analytical input in support of BA's policy processes, in line with FPAS best practices (Mæhle et al., 2021). Impulse responses to key structural shocks offer a reasonable interpretation of economic effects and the policy reactions needed to stabilize the economy and achieve policymakers' objectives. In addition to its theoretical sound properties, historical decompositions provide convincing narratives for key driving forces during specific episodes while in-sample simulations confirm the model's empirical coherence.

The ongoing operationalization of AMPM aims to establish it as the central element of the BA's FPAS and a regular input for BA's decision-making. BA staff have developed specialized sectoral expertise to monitor, analyze and interpret relevant data, prepare nowcasts and near-term forecasts, and formulate coherent narratives and recommendations while ensuring consistency in assumptions and forecasts across sectors. Complementary (non-QPM-based) analyses are used to apply judgments for QPM-based initial conditions and forecasts, construct alternative scenarios, and formulate consistent narratives and policy implications. All activities are detailed in a day-by-day forecast calendar specifying tasks, deadlines, responsibilities, and deliverables. Accordingly, the newly developed FPAS, with AMPM at its core, allows BA staff to assess the economy in a fully consistent framework, providing insights into its current state and potential future tendencies, and thus helping policymakers make informed decisions regarding medium-term monetary policy formulation. Alongside baseline forecasts, alternative scenarios are constructed to analyze risk factors (e.g., deviations of global energy price trajectories from those assumed in the baseline) and their implications for monetary policy in a model-consistent framework. See Bank of Algeria (2025) for further details.

Accordingly, AMPM is used to build baseline forecasts and alternative scenarios in support of the BA's policy process under the current monetary policy framework. However, it can be adjusted and recalibrated such as to allow conducting model-based simulations surrounding prospective BA's monetary policy framework design and strategy. In particular, it can compare and inform policymakers about the implications of different operational and strategy components of monetary policy (instruments, strength of the transmission channels, operating targets and ultimate objectives) within a "positive analysis" paradigm. For example, the model can be employed to evaluate different policy trajectories and (combination of) policy instruments in moving from the current quantity-based framework to an interest rate-based one, with a clearer nominal anchor; see IMF (2025b).

In relation to the existing literature on practical semi-structural models developed to provide regular analytical support to central bank policymakers, AMPM described in this paper is based on the canonical New-Keynesian

structure introduced in Berg et al. (2006). However, successive extensions added to reflect Algeria-specific elements make it similar to the recently developed large-scale, multiple-instrument modeling frameworks, introduced in Berg et al. (2023). Other recent contributions of similar structure and size include Al-Sharkas et al. (2023) for Jordan and Dakila et al. (2024) for the Philippines. Moreover, this paper significantly contributes to the limited analytical economic literature on Algeria. Prior advances include IMF (2017), Meibel and Belarbi (2017), and Bank of Algeria (2022), all documenting empirical evidence on inflation dynamics in Algeria. Additionally, IMF (2016), presents a structural model tailored to Algeria to analyze the propagation of permanent oil price shocks under different exchange rate regime assumptions.

The rest of the paper is structured as follows. Section 2 presents the key stylized facts regarding the Algerian economy and the policy landscape that motivated the specification of AMPM. Section 3 details the structure of the model. Section 4 presents the key results motivating the performance of AMPM, including both theoretical and empirical consistency. Section 5 concludes.

2. Key Stylized Facts and Model Motivation

AMPM ensures its relevance for the BA's monetary policy making by capturing the key features of the Algerian economy, including its status as major energy exporter and the importance of the hydrocarbon sector for aggregate economic activity, as well as the authorities' policy conduct. It explores the substantial fiscal policy influence on overall economic developments, short-term money market characteristics, BA's liquidity management, the exchange rate regime, and external linkages. The general equilibrium feature of AMPM incorporates, in a fully model-consistent framework, the interlinkages among these elements, intersectoral spillovers and interactions across different policies. This section explores the key stylized facts of the Algerian economy that motivated the structure and specification of AMPM.[7] See IMF (2025a) for a recent assessment of the Algerian economic situation, outlook, and policy recommendations.

2.1 Inflation: Core and Non-Core Components

Given the heterogeneity in terms of statistical properties, driving forces and implications for monetary policy conduct of sectoral price dynamics, BA's analytical framework decomposes the consumer price index (CPI) into core and non-core components.[8] Non-core items, accounting for 17 percent of the expenditure basket, include fresh food, whose prices are impacted by weather conditions and government price control measures to preserve essential food purchasing power, which are largely outside the BA's influence. Core prices (processed food, manufactured goods, and services), partly influenced by internal demand and exchange rate, are used to define the medium-term price stability objective, with 4 percent annual core inflation goal.

Figure 1 shows CPI, core, and non-core year-over-year (yoy) inflation rates. Over the past two decades, Algerian inflation has been influenced by government spending, agricultural challenges, weather-related supply shocks, and the COVID-19 pandemic. Non-core inflation saw, on average, subdued dynamics in mid-2000s and pre-pandemic, with significant spikes in 2008-12 and recently. Core prices were relatively stable during

---

[7] The sources of the data presented in this section are: National Statistics Office (ONS), Bank of Algeria, Ministry of Finance, and International Monetary Fund.

[8] The base year for Algeria's CPI basket is 2001 and the weights of CPI items are significantly outdated, complicating decision making; see IMF (2024).

2003-15, with annual core inflation averaging 3.5 percent and fluctuating between 0.5 and 6.5 percent. However, inflationary pressures increased afterwards, reflecting higher import prices due to dinar depreciation, excess liquidity from increased current public spending, and inefficiencies in the distribution chains (e.g., logistical delays and input shortages in certain sectors). Following the initial phase of the COVID-19 pandemic, weak global and domestic demand had significant deflationary effects. Then, core prices accelerated due to the reopening effects and increased demand during the economic recovery, which substantially disrupted global supply chains. The long-term discrepancy between core and non-core inflation (given by sample average inflation rates of 4.2 percent for core and 7.1 percent for non-core) indicates specific relative price trends, explicitly accounted for in AMPM.

Figure 1: Inflation dynamics (percent yoy)
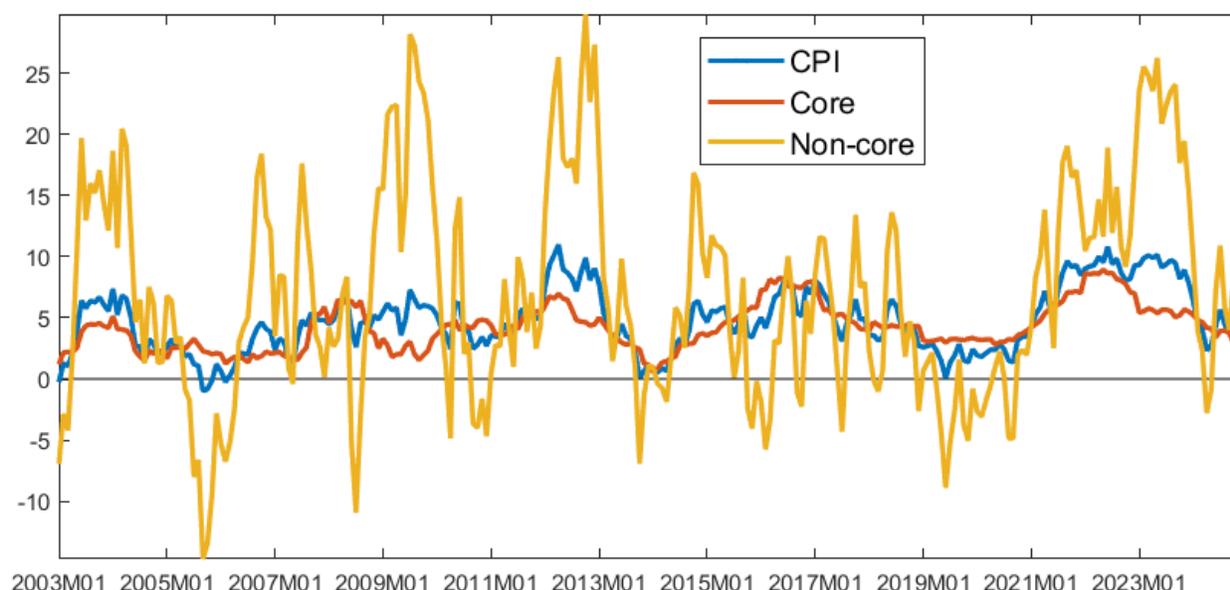
2.2 Economic Activity and Production-Side Decomposition

Figure 2 shows GDP growth over the past two decades, decomposed into two main sectors.[9] It highlights the importance of the extractive sector—primarily oil and gas—in aggregate economic activity. Between 2010-14, real GDP grew by an average of 3.4 percent annually, driven by non-extractive sectors. High oil and gas prices allowed increased government spending and stimulated domestic demand, despite declining volumes of hydrocarbon production. From 2015-19, real GDP growth slowed to 2.2 percent due to reduced non-extractive sector growth and moderate contraction in extractive industries. Brent oil prices fell from 100 USD/barrel in 2014 to 53 USD/barrel during 2015-19, leading to decreased government expenditures and international reserves, adversely impacting consumption, investment, and trade. The COVID-19 pandemic caused a sharp but brief contraction due to lockdown measures, global supply chain disruptions and plunging energy demand.

---

[9] In late-2023, *Office National des Statistiques* published rebased National Accounts data, following the adoption of the United Nations System of National Accounts (2008 SNA) and the alignment with new survey methodology. While there are moderate revisions in nominal series, real GDP growth rates remained largely unchanged; see Annex VIII in IMF (2024). The new methodology revised the classification of economic sectors, in particular switching from "hydrocarbons" to "extractive industries", with the latter comprising an expanded set of minerals. In this context, the initial specification of AMPM, based on previous National Accounts classification and featuring the decomposition of GDP into hydrocarbon and non-hydrocarbon sectors, was recalibrated and adjusted to extractive and non-extractive sectors—as presented in this paper. Given the large overlap between the two definitions, in the text we treat the concepts of "(non-)hydrocarbon" and "(non-)extractive" interchangeably.

Between 2021-23, real GDP rebounded above pre-pandemic levels, averaging 3.8 percent annual growth, driven by both non-extractive and extractive sectors, and supported by stimulative monetary and fiscal policies.

Figure 2: Real GDP growth (percent yoy) and sectoral contributions (pp)
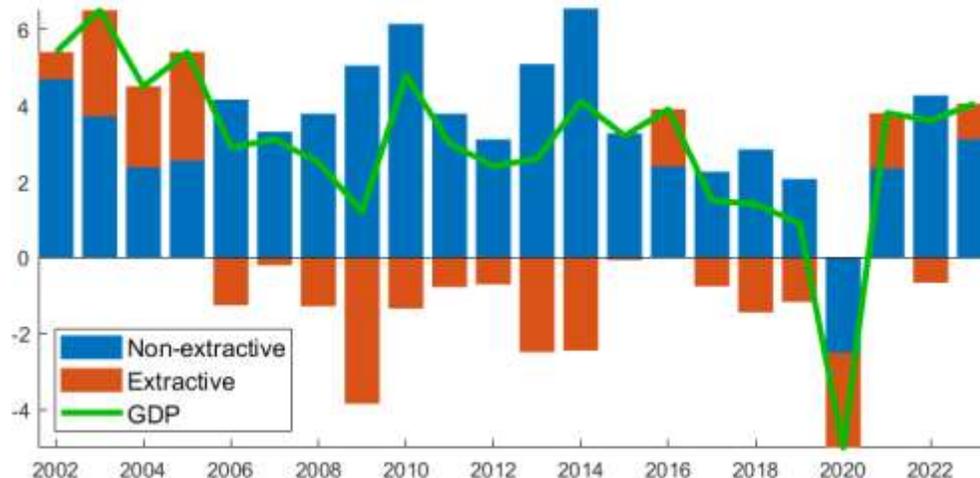
2.3 Fiscal Policy and Public Debt

Public finances shifted from significant surpluses during most of the 2000s to growing deficits starting in 2009 (Figure 3, left panel; positive values indicate deficits and negative values indicate surpluses). The last decade has seen systematic fiscal deficits, driven by the sensitivity of public finances to international energy prices and continuous increases in public spending, particularly current transfers, only partially offset by intermittent consolidation efforts.

Figure 3: Fiscal deficit (left) and public debt (right), GDP ratios
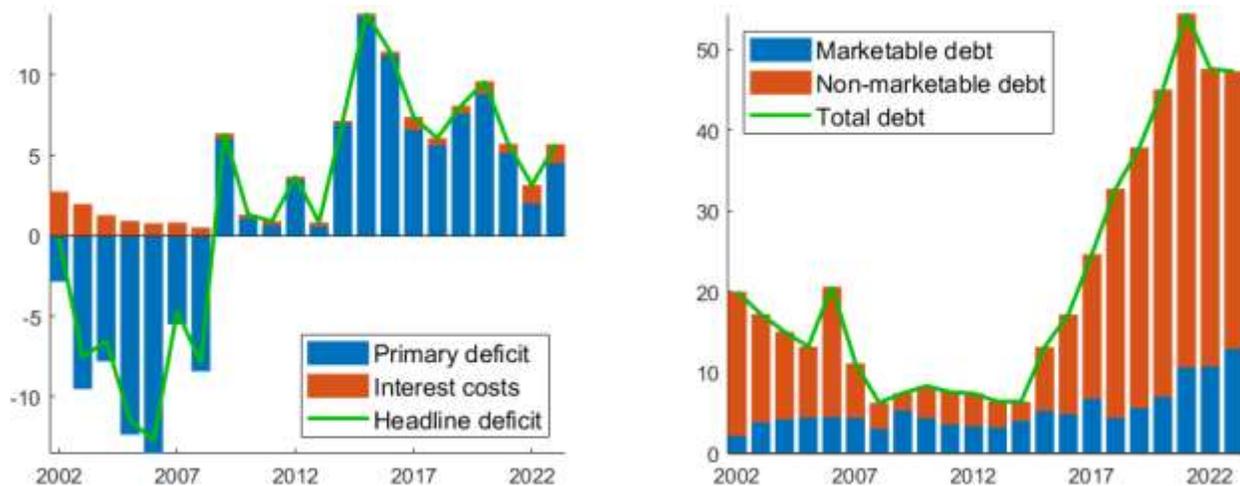
For analytical purposes, total public debt[10] is decomposed into marketable and non-marketable components (Figure 3, right panel). Non-marketable debt includes funds ultimately reflected on BA's balance sheet, while marketable debt consists of standard debt instruments held by the financial sector (excluding BA). Consistent with systematic positive fiscal balances (surpluses), the ratio of domestic public debt to GDP decreased from 2002 to 2008 (except in 2006, due to a temporary advance from the BA[11]), and then stabilized between 5-10 percent from 2008 to 2014. However, since 2015, the total debt ratio has risen due to declining hydrocarbon tax revenues and persistent fiscal deficits, peaking at 54.5 percent at the end of 2021. This increase was partly due to the Treasury's purchase of SOB receivables from SOEs under the PSR to support post-pandemic recovery (see IMF, 2024). From 2015 onwards, the stock of domestic public debt has primarily been of non-marketable type, i.e., non-negotiable debt contracted mainly with the BA and at reduced interest rates, thus reducing government's interest expenses.

2.4 Exchange Rate

Throughout the 2000s, the Algerian dinar appreciated gradually due to persistent fiscal and external balance surpluses, as well as accumulation international reserves amid favorable global energy prices (Figure 4, left panel). Subsequently, the dinar steadily depreciated, with occasionally significant depreciation episodes primarily linked to negative oil price shocks (e.g., in 2009 and 2015). Recently, after depreciation pressures during the COVID-19 pandemic, the dinar appreciated starting in August 2022, supported by recovering global hydrocarbon prices.

Figure 4: Nominal and real USD/DZD exchange rate (left: DZD per USD, right: index, 2010=100)
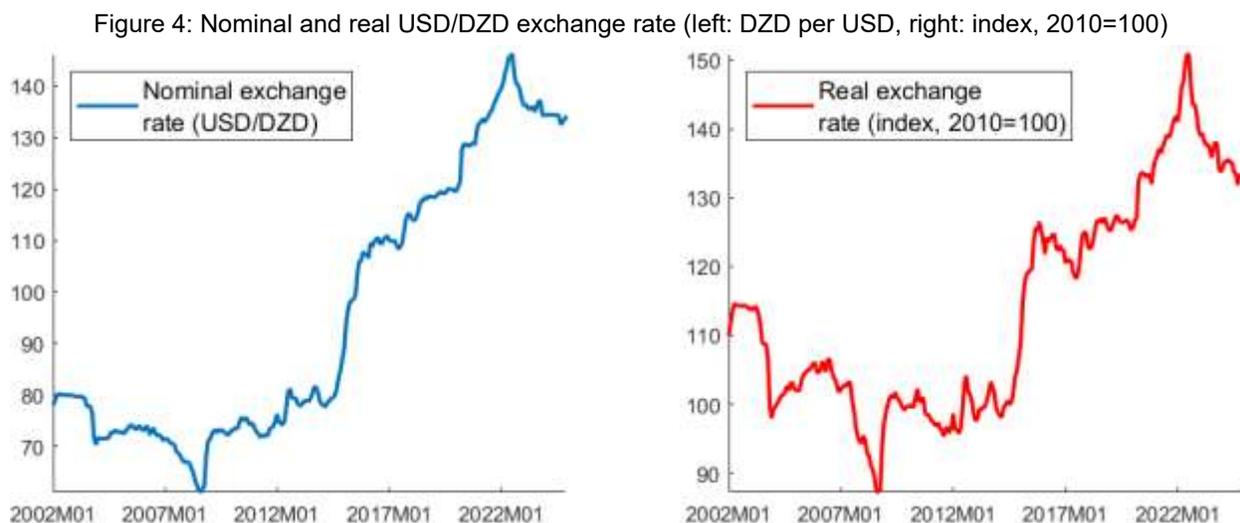
The real exchange rate trajectory primarily mirrors nominal exchange rate trends (Figure 4, right panel). The dinar strengthened in real terms before 2009 and depreciated thereafter. In the current BA framework, the real effective exchange rate (considering the currencies of Algeria's main trading partners) is crucial. The BA adjusts the nominal exchange rate of the dinar against the US dollar to steer the real effective exchange rate toward its equilibrium level, determined by domestic economic fundamentals—including government spending, productivity differentials with foreign trading partners, and openness—and global hydrocarbon price trends.

---

[10] AMPM incorporates only domestic public debt. Algeria's public debt profile is characterized by a significant reliance on internal debt, with external debt playing a negligible role in the country's overall debt structure.
[11] Totaling 627.8 billion DZD according to early payments by the government of the corresponding rescheduled debt.

2.5 Monetary Policy Instruments, Monetary Aggregates, and Interest Rates

The 2023 Monetary and Banking Law specifies price stability as the main objective of monetary policy. To achieve it, the BA uses various instruments depending on specific circumstances and sets the exchange rate reference value to mitigate excessive volatility and align the real effective exchange rate with its equilibrium.

For operational monetary policy implementation consistent with achieving its medium-term inflation objective, the BA uses money supply as the main intermediate target. Implicit M2 targets guide liquidity management tools and are consistent with additional reference values, including stable non-extractive (or non-hydrocarbon) GDP ratios of M2 (excluding hydrocarbon-related deposits) and of credit to the economy. Historically, in response to hydrocarbon inflow fluctuations—during which the signaling role of interbank interest rates was limited—the BA conducted open market operations (OMOs), adjusted required reserve ratios and used deposit facilities to auction additional liquidity, sterilizing net foreign assets and avoiding the build-up of price pressures. In special circumstances, the BA implemented exceptional instruments to address major economic challenges, like providing additional liquidity under specific conditions as part of the PSR. Figure 5 provides an overview of all tools currently employed by the BA to achieve its objectives and fulfill its mandate.

Figure 5: BA monetary policy tools

In the monetary targeting regime, M2 targets for the end of each year are "indicative" rather than strict numerical goals, leading to moderate annual M2 growth fluctuations over the last two decades (Figure 6, left panel). Recently, changes to the key policy rate and adjustments to lending and deposit standing facility rates have been infrequent, despite significant fluctuations in interbank rates, which have generally been below the key policy rate (Figure 6, right panel). These trends reflect the dominance of SOBs and limited market competition, as well as the economy's exposure to global energy price fluctuations.

Figure 6: M2 growth (percent yoy) and interest rates (percent)
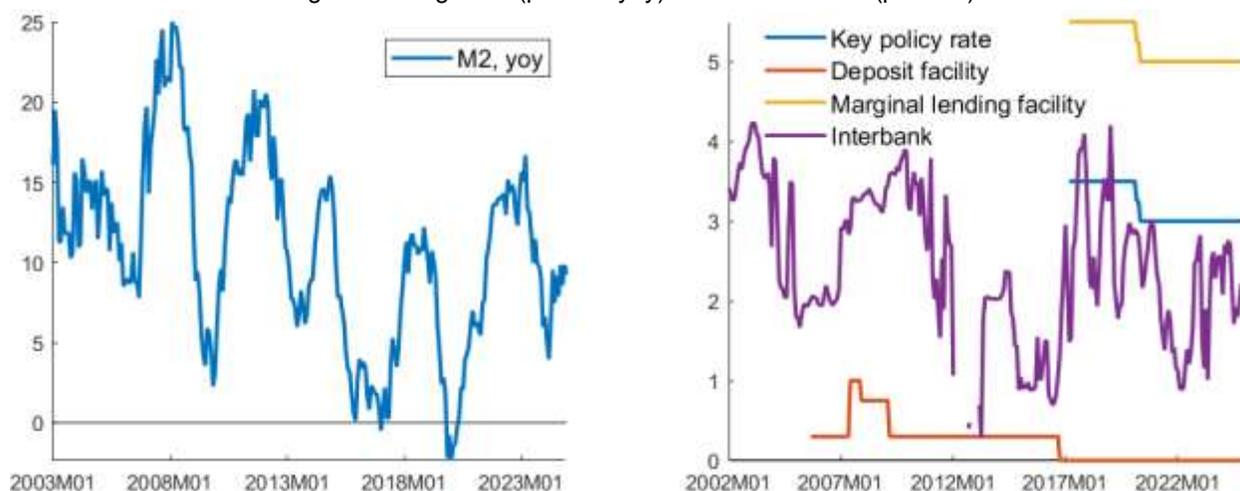
2.6 External Balance and Trade

International trade is vital for the Algeria's economy, with oil and gas exports constituting a significant share of the government revenues, while imports are essential for acquiring final and intermediate goods. European Union is Algeria's main trading partner, primarily for energy exports and imports of advanced technologies, industrial equipment, and food products. The US and China are also key partners, with increasing trade shares.

Since 2014, the dominance of extractive exports has declined, while non-extractive exports, though still minor, have gradually increased, reflecting diversification efforts (Figure 7, left panel). Historically, oil dominated extractive exports, but since 2020, the share of oil products (condensate, crude oil, liquified petroleum gas, and refined products) has steadily declined, while gas products (natural gas and LNG) have increased. Algeria's current account balance (CAB) was positive during 2003-14 due to generally high oil prices and systematic trade surpluses, except during the late-2000s global financial crisis (Figure 7, right panel). From 2014 to 2020, the CAB deteriorated, peaking at a deficit of 27.3 billion USD in 2015 due to the sharp decline in oil prices. The post-pandemic surge in energy prices led to a return to surpluses in 2022.

Figure 7: Goods trade balance (left) and current account balance (right), bn USD
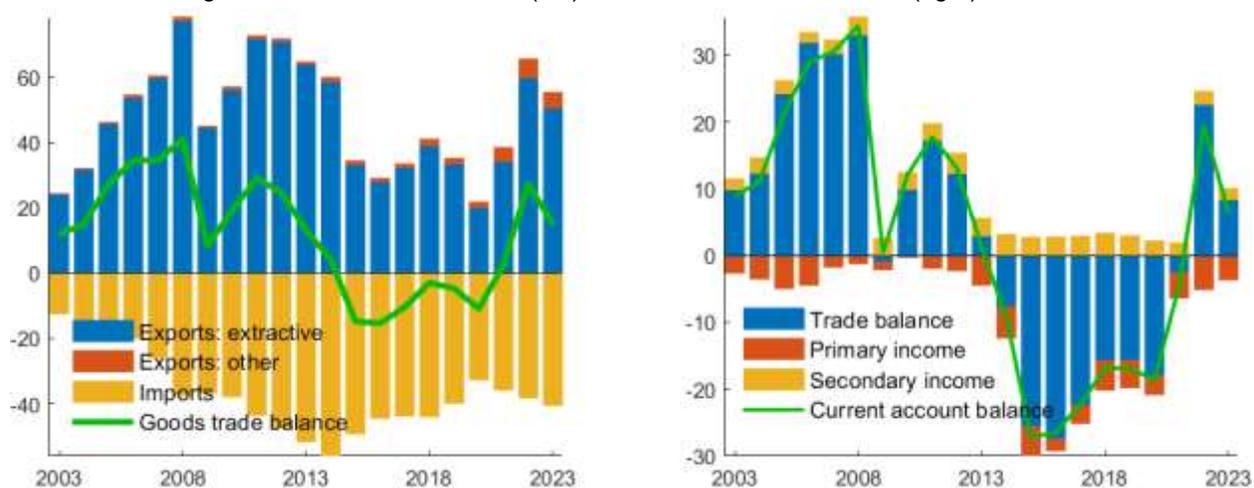
Due to multiple capital controls, the extent of capital account transactions is relatively limited, making the CAB primarily driven by the trade balance. Primary and secondary incomes show small, stable deficits and surpluses, respectively. Consequently, current account transactions are financed mainly through changes in official reserves.

In general, the financial and capital account balance has been positive, except in early-2000s due to significant non-foreign direct investment (non-FDI) outflows for external debt repayments (Figure 8, left panel). FDI flows have remained stable but relatively small. The evolution of official reserves reflects primarily CAB dynamics. From 2003 to 2013, reserves grew from 33 billion USD to 194 billion USD, driven by high oil prices and effective reserves management (including SDR but excluding monetary gold) (Figure 8, right panel). However, this trend reversed sharply from 2014, with reserves falling to 48 billion USD by the end of 2020 due to low oil prices and marginal import adjustments, necessitating the use of reserves to finance current account transactions. Recently, with the return of current account surpluses, there has been a modest recovery in international reserves, though levels remain significantly lower than the early 2010s peak.

Figure 8: Financial and capital account (left) and international reserves (right), bn USD
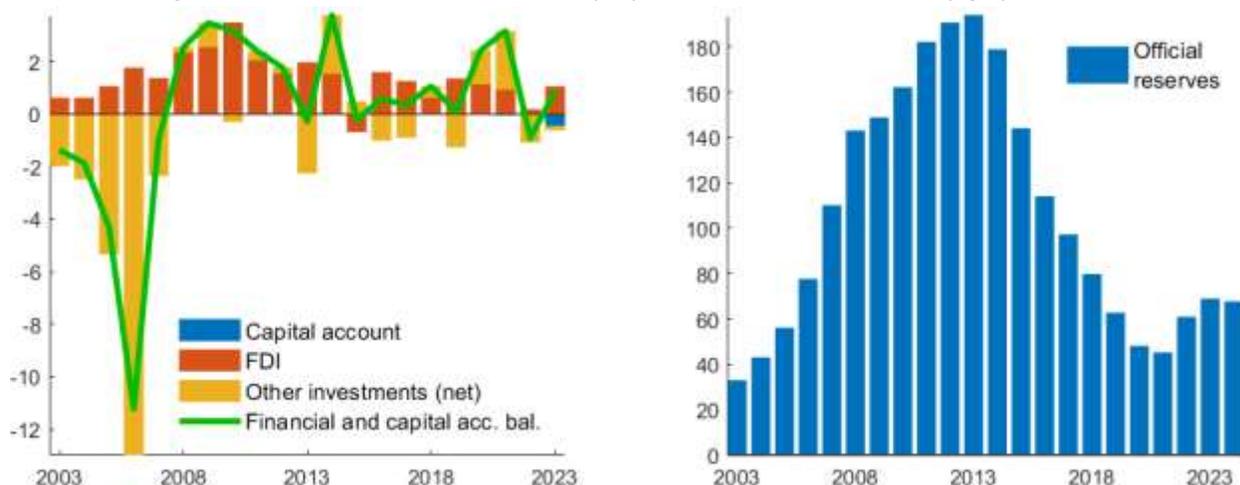
3. Model Structure

AMPM builds upon the New-Keynesian semi-structural quarterly trend-gap framework of Berg et al. (2006), featuring several core domestic blocks and an exogenous external block. It reflects the stylized facts of the Algerian economy documented in the previous section, including the significant role of hydrocarbon exports for economic growth, fiscal policy, and external balance. The model incorporates institutional features, including the BA's monetary policy framework, which targets money supply under a managed exchange rate and a predominantly closed capital account, and a parsimonious fiscal block that anchors public debt accumulation through a fiscal reaction function for the structural deficit. It explicitly models FX reserves accumulation and their interaction with external flows and current account dynamics, forming the core of the external sector / balance of payments block. The model is calibrated to be consistent with economic theory, demonstrated by impulse response functions, and provides a coherent interpretation of historical developments in terms of data filtration and sound in-sample forecasting performance, as shown in the next section.

The multivariate Kalman filter is applied to estimate the gaps and trends, ensuring that key economic variables and sectors are mutually endogenous, as reflected in the model's structure and parameterization. While the model focuses on business cycle components—with behavioral equations for gaps—most trend components are modeled using simple univariate first-order autoregressive processes. As a result, the QPM-derived trends may diverge from estimates obtained through alternative approaches, including those with structural foundations—such as the REER trend aligned with economic fundamentals and policy objectives as in IMF (2025a), the real interest rate trend shaped by demographic dynamics, or potential output estimated via the production function method.

In line with structural macroeconomic models used in central banks, e.g., Al-Sharkas et al. (2023) or Dakila et al. (2024), AMPM features rational expectations when representing the agents' behavior. In particular, it is assumed that economic agents form expectations about future variables—such as inflation (subsection 3.1.2) and exchange rate (subsection 3.3.2)—using all available information and exact structure of the model. This assumption ensures that expectations are model-consistent, allowing forward-looking behavior to be embedded in output, pricing, and policy decisions. Simple model adjustments that allow to account for the impact of monetary policy credibility on the degree of anchoring of inflation expectations are discussed in Abradu-Otoo et al. (2024) and can be considered for future AMPM extensions.

Figure 9 offers a schematic representation of AMPM, including its building blocks, key elements of the monetary policy transmission, and relevant interlinkages among various aggregates. All model variables and equations are listed in Annexes A and B, respectively.

Figure 9: Schematic representation of AMPM
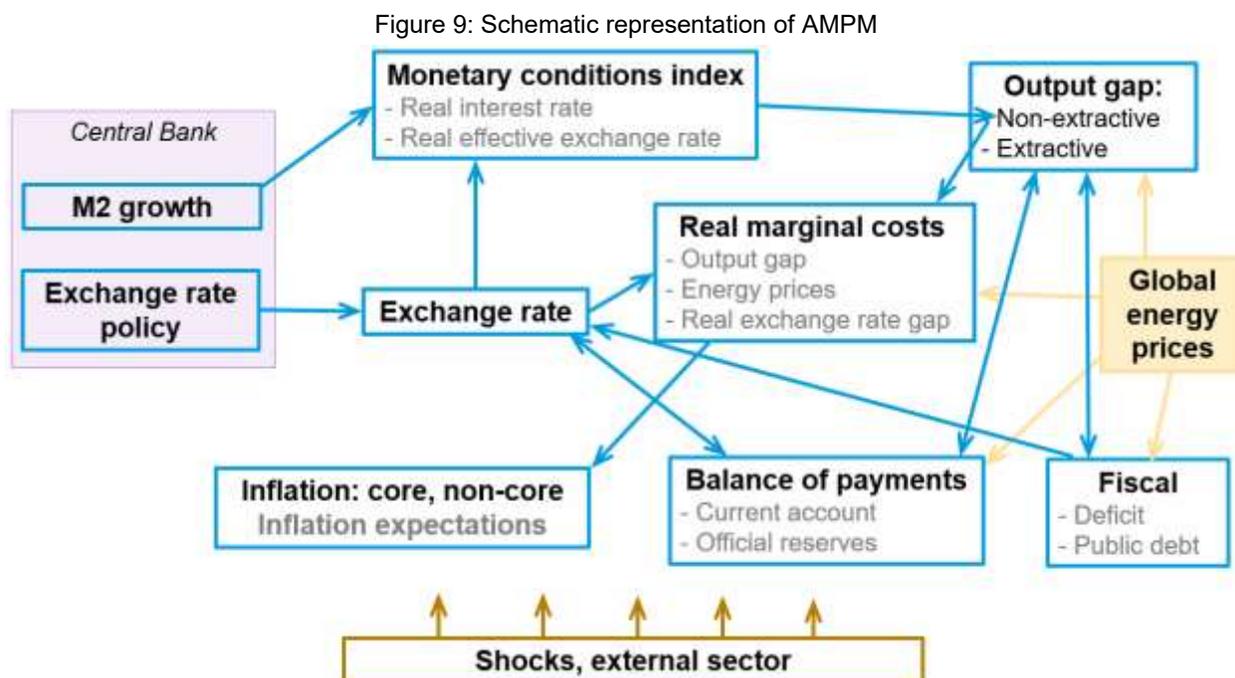
3.1 Internal Balance

3.1.1 Real Economy and Aggregate Demand
Real GDP is disaggregated into two components: extractive (EGDP, denoted in equations below with *e*, and with "hydrocarbon GDP" label used interchangeably) and non-extractive (NEGDP, denoted with *ne*, and with

"non-hydrocarbon GDP" label used interchangeably). This sectoral decomposition highlights the importance of the extractive sector revenues (mainly from oil and gas exports), while other sectors are grouped under NEGDP. Real variables are further split into gap and trend components. The gap components' behavioral equations are linked to macroeconomic theory, while the trends are designed to capture the non-inflationary dynamics of real economic variables. Sectoral growth rates (Δy_t^e and Δy_t^{ne}) and gaps ($\hat{y}_t^e$ and $\hat{y}_t^{ne}$) consistently aggregate to the corresponding total GDP measures:

$$\Delta y_t = w_{y_e} \Delta y_t^e + \left(1 - w_{y_e}\right)\Delta y_t^{ne} + \varepsilon_t^y \tag{1}$$

$$\hat{y}_t = w_{y_e} \hat{y}_t^e + \left(1 - w_{y_e}\right)\hat{y}_t^{ne} \tag{2}$$

Given that the model assumes the extractive GDP sector share (w_{y_e}) is constant, the measurement error (ε_t^y) accounts for time variation in sectoral shares, as well as discrepancies related to seasonal adjustment of the data. The output gap measure based on NEGDP sector serves as a proxy for fundamental business cycle dynamics and, consequently, for changes in domestic producers' marginal costs, which affect consumer prices when demand deviates from the potential level (the non-accelerating inflation rate of output, i.e., the output level that can be produced without generating pressures for inflation to increase or decrease).

The open economy investment-savings (IS) curve for the NEGDP sector posits that the output gap depends on its past values, the real monetary conditions index (mci_t), the trade balance gap ($\widehat{tb}_t^{rat}$), fiscal policy (through the fiscal impulse, $fisc_t$, identified within the fiscal block), and NEGDP demand shocks (ε_t^{yne}):

$$\hat{y}_t^{ne} = b_1^{yne}\hat{y}_{t-1}^{ne} - b_2^{yne}mci_t + b_3^{yne}\widehat{tb}_t^{rat} + b_4^{yne}fisc_t + \varepsilon_t^{yne} \tag{3}$$

Using the trade balance gap ($\widehat{tb}_t^{rat}$) instead of the foreign output gap, as in canonical QPMs without an explicit balance of payments block, captures in a broad sense the impact of external flows and terms of trade fluctuations in an energy-exporting economy. This approach reflects how changes in the relative prices of exports and imports affect aggregate demand and output gap dynamics in the NEGDP sector, beyond just foreign demand. For example, positive spillovers from the extractive sector to certain non-extractive industries (e.g., transport services) can occur proportionally with a rise in oil or gas export values, leading to increased fiscal spending (partly captured through the fiscal impulse) and higher demand for consumption and investment goods.

As in the canonical gap model, the monetary conditions index is measured as a weighted average of the deviation of the real interest rate ($\hat{r}_t$) from its neutral equilibrium level and the real exchange rate gap ($\hat{z}_t$). Positive/negative values of the real exchange rate gap indicate an undervalued/overvalued domestic currency, exerting upward/downward pressures on inflation and providing a stimulative/contractionary impact on NEGDP demand via improved/deteriorated competitiveness.

$$mci_t = c_1^{mci} \hat{r}_t + (1 - c_1^{mci})(-\hat{z}_t) \tag{4}$$

where c_1^{mci} denotes the relative weight of the real interest rate component.

The output gap in the extractive sector depends on past developments, the deviation of international energy prices from their real (deflated by US CPI) equilibrium, $\widehat{zen}_t$, and a sector-specific shock (ε_t^{ye}). The energy price composite gap is a weighted average of the real price gaps of oil ($\widehat{zoil}_t$) and gas ($\widehat{zgas}_t$):

$$\hat{y}_t^e = c_1^{y_e} \hat{y}_{t-1}^e + c_2^{y_e} \widehat{zen}_t + \varepsilon_t^{y_e} \tag{5}$$

$$\widehat{zen}_t = w_{oil} \widehat{zoil}_t + (1 - w_{oil}) \widehat{zgas}_t \tag{6}$$

where w_{oil} denotes the weight of oil in the energy composite (assumed to be constant). The real prices of oil and gas ($zoil_t$ and $zgas_t$) are computed as nominal USD-denominated (observed) prices (oil_t and gas_t) relative to the US CPI (p_t^{rw}), which represents the "rest of the world". Real oil and gas prices are then decomposed into trend (denoted with a "bar") and gap (denoted with a "hat") components:

$$zoil_t = oil_t - p_t^{rw} \tag{7}$$

$$zoil_t = \overline{zoil_t} + \widehat{zoil}_t \tag{8}$$

$$zgas_t = gas_t - p_t^{rw} \tag{9}$$

$$zgas_t = \overline{zgas_t} + \widehat{zgas}_t \tag{10}$$

3.1.2 Inflation and Aggregate Supply

Headline CPI (p_t) is specified as a weighted average of the core and non-core (fresh food) price indices, denoted as p_t^c and p_t^{nc}, respectively. A discrepancy term ($disc_t^p$) accounts for non-additivity due to log approximations and seasonal adjustments.[12]

$$p_t = w_{p_c} p_t^c + (1 - w_{p_c}) p_t^{nc} + disc_t^p \tag{11}$$

where w_{p_c} denotes the weight of the core component.

We define the relative price (rp_t) of core to non-core price levels and decompose it into trend ($\overline{rp}_t$) and gap ($\widehat{rp}_t$) components as follows:

$$rp_t = p_t^c - p_t^{nc} \tag{12}$$

$$rp_t = \overline{rp}_t + \widehat{rp}_t \tag{13}$$

The trend growth in the relative price component is assumed to follow an autoregressive process:

$$\Delta \overline{rp}_t = \rho \overline{rp}_{t-1} + (1 - \rho) \Delta rp_{ss} + \varepsilon_t^{\Delta \overline{rp}} \tag{14}$$

where Δrp_{ss} denotes the steady state relative price growth and $\varepsilon_t^{\Delta \overline{rp}}$ is a shock in trend relative price growth. The exogenous core inflation target, currently specified as 4 percent and reflecting the BA definition of price stability, along with the steady state relative price trend growth, together determine an implicit target for the non-core component.

The open economy forward-looking Phillips curve for core inflation assumes that the quarter-on-quarter (qoq) annualized core inflation rate (π_t^c) depends on its past (π_{t-1}^c) and expected future values ($E_t \pi_{t+1}^c$), where E_t

---

[12] It may also incorporate potential future time variation in the CPI weights. Based on the latest ONS data, CPI weights are constant, with the base year 2001, rendering them significantly outdated and complicating decision making.

represents model-consistent rational expectations, real marginal costs (RMC, rmc_t^c), and sectoral cost-push shocks ($\varepsilon_t^{\pi_c}$):

$$\pi_t^c = c_1^{\pi_c} E_t \pi_{t+1}^c + \left(1 - c_1^{\pi_c}\right)\pi_{t-1}^c + c_2^{\pi_c} rmc_t^c + \varepsilon_t^{\pi_c} \tag{15}$$

The assumed components of the RMC in the equation for core inflation are: (i) the output gap in the non-extractive sector, approximating domestic cost pressures; (ii) the relative energy price, capturing the pass-through of temporary deviations from equilibrium in international oil and gas prices into domestic prices[13]; (iii) the real exchange rate gap (based on core prices), capturing the cost of imported production factors:

$$rmc_t^c = c_1^{rmc_c} \hat{y}_t^{ne} + c_2^{rmc_c} \widehat{zen}_t + \left(1 - c_1^{rmc_c} - c_2^{rmc_c}\right)\hat{z}_t \tag{16}$$

The Phillips curve for non-core (fresh food) inflation has a similar structure to that of core inflation. However, the effects of its determinants differ due to sector-specific parameter calibration.[14]

$$\pi_t^{nc} = c_1^{\pi_{nc}} E_t \pi_{t+1}^{nc} + \left(1 - c_1^{\pi_{nc}}\right)\pi_{t-1}^{nc} + c_2^{\pi_{nc}} rmc_t^{nc} + \varepsilon_t^{\pi_{nc}} \tag{17}$$

$$rmc_t^{nc} = c_1^{rmc_{nc}} \hat{y}_t^{ne} + c_2^{rmc_{nc}} \widehat{zen}_t + \left(1 - c_1^{rmc_{nc}} - c_2^{rmc_{nc}}\right)(\hat{z}_t + \widehat{rp}_t) \tag{18}$$

Note that the real exchange rate gap component of the non-core RMC incorporates a relative price gap term, given that the real exchange rate is defined using core prices. Thus, $\hat{z}_t + \widehat{rp}_t$ represents the non-core sector-specific real exchange rate measure.

3.2 External Balance

The balance of payments (BOP) is represented by the identity (all variables are expressed as ratios to nominal GDP):

$$ca_t^{rat} + kfa_t^{rat} = 0 \tag{19}$$

The BOP states that current account (ca_t^{rat}), comprising net export of goods and services plus net primary and secondary income, matches the capital and financial account (kfa_t^{rat}), which consists of flows of financial claims, including in official reserves. In other words, the sum of the current account, private financial flows, and changes in reserves equals zero.

Since Algeria's current account is mainly influenced by the balance of goods and services, the external sector extension focuses on the determinants of the trade balance (tb_t^{rat}). Developments in net primary income (payments for the use of labor and capital) and net secondary income (such as grants and remittances) are summarized by the residual variable $ca_t^{other,rat}$. The trade balance is decomposed into gap and trend components ($\widehat{tb}_t^{rat}$ and $\overline{tb}_t^{rat}$). Given the relatively small and stable importance of other current account

---

[13] While domestic energy prices are largely regulated and the pass-through from global oil and gas prices is very limited, additional effects may arise indirectly, for example via increased shipping and transportation costs. Thus, the calibrated weight ($c_2^{rmc_c}$) is small but still non-zero.

[14] For the QPM-based analysis of weather shocks identified as food price shocks, similar to $\varepsilon_t^{\pi_{nc}}$ in equation (17), in the context of developing countries see Nalban and Zanna (2025).

components (see Section 2), we simplify the external block by not modeling this term in detail, assuming the current account gap equals the trade balance gap.

$$ca_t^{rat} = tb_t^{rat} + ca_t^{other,rat} \tag{20}$$

$$\widehat{ca}_t^{rat} = \widehat{tb}_t^{rat} \tag{21}$$

$$tb_t^{rat} = \widehat{tb}_t^{rat} + \overline{tb}_t^{rat} \tag{22}$$

The following equation defines the determinants of the trade balance gap:

$$\widehat{tb}_t^{rat} = c_1^{\overline{tb}^{rat}} \widehat{tb}_{t-1}^{rat} + \left(1 - c_1^{tb^{rat}}\right) \cdot$$
$$\left(c_2^{tb^{rat}} \widehat{zen}_t + c_3^{tb^{rat}} \hat{y}_t^{rw} - c_4^{tb^{rat}} \hat{y}_t^{ne} + c_5^{tb^{rat}} \hat{y}_t^{e} + c_6^{tb^{rat}} \hat{z}_t - c_7^{tb^{rat}} (pdef_t^{rat,struct} - pdef_t^{rat,tar})\right) + \varepsilon_t^{\widehat{tb}^{rat}} \tag{23}$$

The trade balance gap depends positively on the real energy price gap ($\widehat{zen}_t$), the extractive output gap ($\hat{y}_t^e$), and foreign demand ($\hat{y}_t^{rw}$, proxying non-energy exports and defined as trade partners' output gap). In addition, a typical expenditure-switching mechanism is introduced, whereby the trade balance depends positively on competitiveness (assessed through the real exchange rate gap, $\hat{z}_t$). Finally, it is assumed that the trade balance deteriorates via an increase in import demand, which is assumed to originate both from the private sector, proxied by the non-extractive output gap ($\hat{y}_t^{ne}$), and the public sector, proxied by the difference between structural primary deficit and its target ($pdef_t^{rat,struct} - pdef_t^{rat,tar}$). The deviations from this behavioral equation are captured by a shock ($\varepsilon_t^{\widehat{tb}^{rat}}$).

The trade balance trend is assumed to follow a simple autoregressive process around its steady state ($\overline{tb}_{ss}^{rat}$), adjusted for the deviation of real energy price trend growth from its steady state ($\Delta \overline{zen}_t - \Delta \overline{zen}_{ss}$):

$$\overline{tb}_t^{rat} = c_1^{\overline{tb}^{rat}} \overline{tb}_{t-1}^{rat} + \left(1 - c_1^{\overline{tb}^{rat}}\right) \left(\overline{tb}_{ss}^{rat} + c_2^{\overline{tb}^{rat}} (\Delta \overline{zen}_t - \Delta \overline{zen}_{ss})\right) + \varepsilon_t^{\overline{tb}^{rat}} \tag{24}$$

The trend for the remaining current account items is designed in a simple way to keep the external block parsimonious. In particular, the dynamics of $\overline{tb}_t^{rat}$ are the main driver of $\overline{ca}_t^{rat}$, while $ca_t^{other,rat}$ is assumed to follow an autoregressive process around its steady state ($ca_{ss}^{other,rat}$) and a shock:

$$\overline{ca}_t^{rat} = \overline{tb}_t^{rat} + \left(ca_t^{other,rat} - \varepsilon_t^{ca^{other,rat}}\right) \tag{25}$$

$$ca_t^{other,rat} = c_1^{ca^{other,rat}} ca_{t-1}^{other,rat} + \left(1 - c_1^{ca^{other,rat}}\right) ca_{ss}^{other,rat} + \varepsilon_t^{ca^{other,rat}} \tag{26}$$

Financial account inflows (kfa_t^{rat}) are decomposed into changes in reserve-related financing ($resfin_t^{rat}$) and endogenous financial inflows (non-reserve financing, $kfanonres_t^{rat}$).

$$kfa_t^{rat} = kfanonres_t^{rat} - resfin_t^{rat} \tag{27}$$

Since Algeria's capital account is largely closed, with limited endogenous financial inflows, the equation essentially determines the change in reserves to cover the current account balance, given $kfa_t^{rat} = -ca_t^{rat}$.

Endogenous non-reserve financial inflows converge towards their equilibrium ($kfanonres_{ss}^{rat}$) and are sensitive to the expected rate of return on domestic versus foreign interest-bearing assets, captured by the sovereign risk premium ($prem_t$). However, their responsiveness ($c_2^{kfa^{nonres,rat}}$) is calibrated to be small to match the predominantly closed capital account:

$$kfanonres_t^{rat} = c_1^{kfa^{nonres,rat}} kfanonres_{t-1}^{rat} + \left(1 - c_1^{kfa^{nonres,rat}}\right) kfanonres_{ss}^{rat} \ldots$$

$$+ c_2^{kfa^{nonres,rat}} (prem_t - prem_{ss}) + \varepsilon_t^{kfanonres^{rat}} \tag{28}$$

The law of motion for reserve assets (res_t^{rat}) in equation (29) defines the evolution of official reserves given the financing needs for current account transactions ($resfin_t^{rat}$) and the return on the outstanding stock from the previous period, converted to domestic currency and scaled by nominal NEGDP:

$$res_t^{rat} = \frac{resfin_t^{rat}}{4} + res_{t-1}^{rat} \frac{\left(1 + \frac{\Delta s_t}{400}\right)}{\left(1 + \frac{\Delta ny_t^{ne}}{400}\right)} + \varepsilon_t^{res^{rat}} \tag{29}$$

Total net foreign assets (nfa_t^{rat}) in the economy are the sum of official reserve assets (res_t^{rat}) and private sector net foreign assets ($nfa_t^{priv,rat}$). In Algeria, given the requirement to surrender commodity export inflows to the BA, the majority of net foreign assets are represented by the reserve assets of the BA.

$$nfa_t^{rat} = res_t^{rat} + nfa_t^{priv,rat} \tag{30}$$

3.3 Economic Policies

3.3.1 Monetary Policy

Since 2003, monetary aggregates have been central to the BA's monetary policy formulation. AMPM specifies a forward-looking monetary policy reaction function for money supply, defined in terms of the M2 aggregate, which serves as intermediate target. This approach assumes the BA controls the M2 aggregate, allowing to model broad money (M2) directly as the central bank instrument, rather than narrow money (monetary base and/or reserves). M2 growth dynamics can incorporate the impact of various BA instruments presented in Figure 5 (e.g., open market operations or required reserve ratios) on broad money supply, making it a representative proxy for the overall monetary policy stance.

To achieve medium-term price stability, the M2 quarter-on-quarter annualized growth rate (Δm_t) is adjusted based on three-quarter ahead expected deviations of annual core inflation from its target. In addition, monetary policy aims to smooth business cycle fluctuations by keeping aggregate economic activity close to potential (i.e., closing the total output gap, $\hat{y}_t$) and stabilizing the interbank interest rate (rs_t) near its neutral level ($rs_t^{neutral}$). Money supply is also adjusted to align with intermediate targets for broad money annual growth ($\Delta^4 m_t^{tar}$). In practice, the BA sets M2 targets to incorporate intermediate targets for credit to the economy and other guideposts, such as stable ratios of M2 to NEGDP and of credit to economy to NEGDP. Changes in official reserves (res_t^{rat}) may also cause money supply fluctuations, if not fully sterilized, consistent with historical data correlations. Finally, M2 dynamics also reflect policymakers' preference to avoid large fluctuations through a persistence term (Δm_{t-1}), while non-systemic developments are captured by a money supply shock ($\varepsilon_t^{\Delta m}$). These considerations are incorporated in the following M2 reaction function:

$$\Delta m_t = c_1^m \Delta m_{t-1} + (1 - c_1^m)[\Delta \overline{rm}_t + (\pi_t^{4,tar} - (1 - w_{pc})\Delta rp_t^{tnd}) \ldots$$
$$\ldots + c_2^m(rs_t - rs_t^{neutral}) - c_3^m \pi_t^{4,dev} - c_4^m \hat{y}_t - c_5^m (\Delta m_t - \Delta^4 m_t^{tar})] \ldots$$
$$+ c_6^m(res_t^{rat} - res_{t-1}^{rat}) + \varepsilon_t^{\Delta m} \tag{31}$$

where $\Delta \overline{rm}_t$ represents trend real M2 growth, while $(\Delta \overline{rm}_t + (\pi_t^{4,tar} - (1 - w_{pc})\Delta rp_t^{tnd}))$ is its nominal counterpart. Price stability determinant, $\pi_t^{4,dev}$, is defined as $(E_t \pi_{t+3}^{4,c} - \pi_{t+3}^{4,tar})$.

Consistent with the quantity theory of money (expressed in growth rates) and embedded as a steady state condition in AMPM, the real money growth trend is defined as output trend growth (the weighted average of EGDP and NEGDP trends, i.e., $\Delta \overline{y_t^e}$ and $\Delta \overline{y_t^{ne}}$, respectively), adjusted by the change in velocity (Δv_t), the change in the real interest rate trend ($\bar{r}_t$), and a shock term ($\varepsilon_t^{\Delta \overline{rm}}$):

$$\Delta \overline{rm}_t = w_{y_e} \Delta \overline{y_t^e} + (1 - w_{y_e})\Delta \overline{y_t^{ne}} - \Delta v_t - c_1^{\Delta \overline{rm}}(\bar{r}_t - \bar{r}_{t-1}) + \varepsilon_t^{\Delta \overline{rm}} \tag{32}$$

Real money is defined with respect to total CPI:

$$rm_t = m_t - p_t \tag{33}$$

Similarly, the real money target is defined as the nominal target relative to CPI:

$$rm_t^{tar} = m_t^{tar} - p_t \tag{34}$$

The dynamics of nominal money growth target (Δm_t^{tar}) consist of an autoregressive term and are linked to the trend nominal NEGDP growth ($\Delta \overline{ny_{ss}^{ne}}$) and the previous period deviation of the real money target from the corresponding trend (an error correction term). Unexplained dynamics are absorbed by a shock ($\varepsilon_t^{m_{tar}}$):

$$\Delta m_t^{tar} = c_1^{m_{tar}} \Delta m_{t-1}^{tar} + (1 - c_1^{m_{tar}})\Delta \overline{ny_{ss}^{ne}} - c_2^{m_{tar}}(rm_{t-1}^{tar} - \overline{rm}_{t-1}) + \varepsilon_t^{m_{tar}} \tag{35}$$

Finally, real money demand, approximated by the real money gap ($\widehat{rm}_t$), depends on real interest rate gap ($\hat{r}_t$), total output gap ($\hat{y}_t$), government financing needs (defined in terms of debt ratio deviation from its target ($debt_t^{rat} - debt^{rat,tar}$), liquidity effects coming from changes in official reserves ($res_t^{rat} - res_{t-1}^{rat}$), and a money demand shock (ε_t^{rm}):

$$\widehat{rm}_t = c_1^{rm}\widehat{rm}_{t-1} - c_2^{rm}\hat{r}_t + c_3^{rm}\hat{y}_t + c_4^{rm} (debt_t^{rat} - debt^{rat,tar}) + c_5^{rm}(res_t^{rat} - res_{t-1}^{rat}) + \varepsilon_t^{rm} \tag{36}$$

3.3.2 Exchange Rate Policy

According to AREAER, Algeria's de jure exchange rate arrangement is "managed floating", while the de facto exchange rate arrangement has been classified as crawl-like or stabilized arrangement in recent years. AMPM assumes an explicit nominal exchange rate depreciation target, reflecting the long-term depreciation trend of the dinar (as documented in Section 2).

With Algeria's largely closed financial account and the mandatory exchange of FX income for dinar by commodity exporters with the BA, the Bank can set the reference path of the exchange rate. The exchange rate (s_t) is determined by the BA reference rate (exchange rate policy target depreciation rate, Δs_t^{pol}, with a

weight of c_1^s) and to some limited extent (complementary weight $1 - c_1^s$) also by the modified UIP condition. The latter states that current-quarter exchange rate equals the next-period expected exchange rate ($s_{t+1}{}^F$) plus the risk-adjusted interest rate differential defined as ($rs_t - rs_t^{rw} - prem_t$), where rs_t is the domestic interbank rate, rs_t^{rw} is the Fed funds rate, and $prem_t$ is the sovereign risk premium. Economic developments affecting the trade balance ($\widehat{tb}_t^{rat}$) and excessive government debt accumulation ($debt_t^{rat} - debt^{rat,tar}$) can also exert pressure on the nominal exchange rate (with the strength of these effects captured by c_3^s and c_4^s, respectively), and can be interpreted as an endogenous component of the sovereign risk premium:

$$
\begin{aligned}
s_t = c_1^s \left\{ s_{t-1} + \frac{\Delta s_t^{pol}}{4} \right\} + \cdots \\
(1 - c_1^s) \left\{ s_{t+1}{}^F - (rs_t - rs_t^{rw} - prem_t)/4) \right\} + \cdots \\
(1 - c_1^s) \left\{ -c_3^s \, \widehat{tb}_t^{rat} + c_4^s \, (debt_t^{rat} - debt^{rat,tar}) \right\} + \varepsilon_t^s
\end{aligned}
\tag{37}
$$

where ε_t^s is an exchange rate shock.

Exchange rate expectations incorporate both forward-looking elements, defined by model-consistent rational expectations, and backward-looking components linked to the nominal exchange rate target:

$$
s_{t+1}{}^F = c_2^s \, E_t s_{t+1} + (1 - c_2^s) \left\{ s_{t-1} + \frac{2}{4} \Delta s_t^{tar} \right\}
\tag{38}
$$

In the long term, relative purchasing power parity is assumed to hold. Therefore, to achieve the domestic medium-term inflation objective, the target exchange rate depreciation is set consistent with the change in the real exchange rate trend ($\Delta \bar{z}_t$) and the long-term inflation rates (targets) differential between domestic ($\pi_t^{4,tar}$) and foreign ($\pi_t^{4,rw}$) economies:

$$
\Delta s_t^{tar} = \Delta \bar{z}_t - \pi_t^{4,rw} + \pi_t^{4,tar}
\tag{39}
$$

The nominal exchange rate policy assumes the BA sets the dinar reference value (Δs_t^{pol}) to mitigate its excessive volatility and also target a real exchange rate aligned with its fundamental value, i.e., to close the real exchange rate gap ($\hat{z}_t$).[15] In addition, the exchange rate is occasionally adjusted to mitigate price pressures, reflecting the primacy of price stability among BA objectives, and is thus influenced by the deviation of expected annual core inflation from the target ($\pi_t^{4,dev}$, i.e., the same term as in the M2 reaction function):

$$
\Delta s_t^{pol} = c_1^{Spol} \Delta s_{t-1}^{pol} + \left(1 - c_1^{Spol} \right) \left\{ \Delta s_t^{tar} - c_2^{Spol} \hat{z}_t - c_3^{Spol} \pi_t^{4,dev} \right\} + \varepsilon_t^{Spol}
\tag{40}
$$

3.3.3 Fiscal Policy
AMPM includes a parsimonious fiscal block that anchors public debt accumulation based on a fiscal reaction function for the structural primary deficit (adjusted for the domestic NEGDP business and commodity price cycles). This block provides a consistent stock-flow analysis for the public debt trajectory and government total

---

[15] Ongoing model extensions agenda include introducing rest of the world in effective terms, i.e., weighting trade partners' variables according to their relative importance for Algeria's international trade. This includes adopting an effective exchange rate concept (vis-à-vis only the USD bilateral exchange rate currently). However, the marginal contribution of this extension is expected to be limited given the centrality of USD for the BA's framework.

and primary deficits. The framework focuses on aggregate balance measures, without detailing government revenue and expenditure components, and expresses fiscal variables as shares to total nominal GDP. It can be flexibly complemented by simple calculations (e.g., incorporate the forecast for the government's budget as specified in the Finance Law), spreadsheet-based models for government balances, or other inputs from satellite models.

The fiscal block allows for the analysis of: (i) the macroeconomic effects of fiscal measures (stimulus or restrictiveness); (ii) public debt projections and required fiscal adjustments to ensure debt sustainability; (iii) the macroeconomic implications of different financing choices, such as marketable debt (fixed-income market issuance) and non-marketable debt (ad-hoc sovereign securities, typically with low interest rates and not available on the secondary market); and (iv) interactions between fiscal and monetary policy.

The government deficit (def_t^{rat}) is divided into primary deficit ($pdef_t^{rat}$) and interest payments to service debt ($intcost_t^{rat}$):

$$def_t^{rat} = pdef_t^{rat} + intcost_t^{rat} + \varepsilon_t^{def^{rat}} \tag{41}$$

The shock ($\varepsilon_t^{def^{rat}}$) reflects a simplification, since the model assumes outstanding debt is represented only by generic debt instruments with a 1-year maturity (see below). The primary deficit is further decomposed into structural ($pdef_t^{rat,struct}$) and cyclical ($pdef_t^{rat,cyc}$) components:

$$pdef_t^{rat} = pdef_t^{rat,struct} + pdef_t^{rat,cyc} + \varepsilon_t^{pdef^{rat}} \tag{42}$$

The shock ($\varepsilon_t^{pdef^{rat}}$) incorporates specific assumptions regarding the cyclical versus structural components. The cyclical deficit is linked to the business cycle, or the output gap in the non-extractive sector (automatic stabilizers), and deviations from the equilibrium of international real energy prices:

$$pdef_t^{rat,cyc} = -c_1^{pdef^{rat,cyc}} \hat{y}_t^{ne} - c_2^{pdef^{rat,cyc}} \widehat{zen}_t + \varepsilon_t^{pdef^{rat,cyc}} \tag{43}$$

The cyclical component of the fiscal deficit adjusts for the effects of the domestic business cycle and global energy market developments, given the importance of hydrocarbon exports for government finances. The shock ($\varepsilon_t^{pdef^{rat,cyc}}$) captures deviations from this relationship.

The fiscal authority adjusts structural deficits ($pdef_t^{rat,struct}$) to ensure debt converges to sustainable levels while providing countercyclical economic support. The following equation for the structural deficit constitutes the fiscal policy reaction function, capturing two objectives. First, fiscal policy is anchored by the debt target, e.g., an excessive government debt accumulation requires a consolidation plan to reduce the structural deficit and achieve the targeted debt level, i.e., closing the "debt gap" ($\widehat{debt}_t^{rat}$). Second, economic stabilization refers to fiscal policy aiming to smooth cyclical fluctuations and stabilize the real economy at its potential by closing the NEGDP gap ($\hat{y}_t^{ne}$):

$$pdef_t^{rat,struct} = \rho_{def} \left(pdef_{t-1}^{rat,struct} - c_1^{pdef^{rat,struc}} \hat{y}_t^{ne} \right) + \cdots$$
$$(1 - \rho_{def}) \left(pdef_t^{rat,tar} - c_2^{pdef^{rat,struct}} \widehat{debt}_t^{rat} \right) + \varepsilon_t^{defstruct^{rat}} \tag{44}$$

The calibration of AMPM incorporates some policy smoothing alongside countercyclical fiscal policy, as captured by the lagged term ($pdef_{t-1}^{rat,struct}$). Structural deficits adjust to debt deviations from the target level ($\widehat{debt}_t^{rat}$), aligning with the corresponding structural deficit target ($pdef_t^{rat,tar}$). The parameters ($c_1^{pdef^{rat,struc}}$ and $c_2^{pdef^{rat,struc}}$) determine the relative importance of the two objectives, while the shock ($\varepsilon_t^{defstruct^{rat}}$) accounts for deviations from the assumed systematic fiscal reaction.

The debt deviation from the target is defined as a weighted average of current and expected deviations:

$$\widehat{debt}_t^{rat} = c_1^{debt^{rat}}\left(debt_t^{rat} - debt_t^{rat,tar}\right) + \left(1 - c_1^{debt^{rat}}\right)E_t\widehat{debt}_{t+1}^{rat} \tag{45}$$

The fiscal anchor is the target ratio of total debt to nominal GDP, assumed to follow an autoregressive process reverting to the steady state ($debt^{rat,ss}$):

$$debt_t^{rat,tar} = \rho\, debt_{t-1}^{rat,tar} + (1-\rho)debt^{rat,ss} + \varepsilon_t^{debt^{rat,tar}} \tag{46}$$

The fiscal impulse captures the impact of fiscal measures on the real economic cycle through discretionary changes in the structural deficit and its deviation from the steady-state target value.

$$fimp_t^{rat} = c_1^{fimp^{rat}}\left(4\cdot\left(pdef_t^{rat,struct} - pdef_{t-1}^{rat,struct}\right)\right) + (1 - c_1^{fimp^{rat}})\left(4\cdot\left(pdef_t^{rat,struct} - pdef_{ss}^{rat,struct}\right)\right) \tag{47}$$

This equation defines the fiscal impulse as consisting of two components: the change in the structural deficit ratio ($pdef_t^{rat,struct} - pdef_{t-1}^{rat,struct}$) and its deviation from the equilibrium level ($pdef_t^{rat,struct} - pdef_{ss}^{rat,struct}$). The former captures quarter-by-quarter changes, while the latter reflects the persistent impact of fiscal deficit deviations, with relative weights defined by the parameter $c_1^{fimp^{rat}}$.

Given the budget deficit is measured on a cash basis, the resulting quarterly flows—and thus the fiscal impulse—are quite volatile. In addition, there may be significant delays from the initiation of a fiscal measure to its practical implementation and visible effects on the economic activity. Therefore, the IS curve (3) uses a four-quarter moving average of the fiscal impulse:

$$fisc_t = \frac{1}{4}\cdot\left(fimp_t^{rat} + fimp_{t-1}^{rat} + fimp_{t-2}^{rat} + fimp_{t-3}^{rat}\right) \tag{48}$$

In line with Algeria's current debt management approach and the latest data, all public debt is domestic. Total outstanding debt as a share of nominal GDP ($debt^{rat}$) is the sum of marketable debt ($debt^{m,rat}$) and non-marketable debt ($debt^{nm,rat}$):

$$debt_t^{rat} = debt_t^{m,rat} + debt_t^{nm,rat} \tag{49}$$

Each quarter, the government issues both marketable and non-marketable debt instruments, assuming a generic 1-year maturity for both. These debt flows accumulate, reflecting current and previously issued bonds. The stock of marketable debt is the sum of all previously issued bonds until their maturity. Since the fiscal

variables are specified as shares of nominal GDP, previously issued debt needs to be adjusted by changes in nominal GDP. Therefore, debt accumulation, for $j \in \{m, nm\}$ indexing marketable and non-marketable variables, is specified as:

$$debt_t^{j,rat} = debt1y_t^{j,rat} + \frac{debt1y_{t-1}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400}\right)} + \frac{debt1y_{t-2}^{j,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1}}{400}\right)} + \frac{debt1y_{t-3}^{j,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1} + \Delta ny_{t-2}}{400}\right)} \quad (50)$$

where $debt1y_t^{j,rat}$ is the j-type debt issued in period t (as a ratio of nominal GDP), and Δny_t is nominal GDP growth (annualized quarter-on-quarter change).

Newly issued debt reflects the need to finance the total deficit and replace maturing debt (period $t - 4$ issuances) using the same type of instrument, as well as potential reallocation of debt stocks between marketable and non-marketable components ($restruct_t$):

$$debt1y_t^{j,rat} = share_t^j \cdot def_t^{rat} + \frac{debt1y_{t-4}^{j,rat}}{\exp\left(\frac{\Delta ny_t^4}{100}\right)} - restruct_t + \varepsilon_t^{debt1y_t^{j,rat}} \quad (51)$$

where def_t^{rat} denotes total deficit, $share_t^j = \theta_t$ for $j = m$ and $share_t^j = 1 - \theta_t$ for $j = nm$. Accordingly, θ_t proxies the government's financing plans, defining the share of the total deficit financed by marketable instruments. Measurement errors $\varepsilon_t^{debt1y_t^{j,rat}}$ account for the discrepancies between the budget deficit and public debt data, as well as the differences between the model's assumed debt homogeneity (1-year bonds) and the actual public debt structure (varying maturities, interest rates, etc.).

The share of marketable and non-marketable financing (captured by θ_t) varies over time, reflecting the significant buildup of non-marketable debt over the past decade. In steady state, it is assumed to be 1, meaning the deficit is financed solely through fixed-income market issuances. The variable $restruct_t$ accounts for the restructuring of outstanding debt stocks. For example, in 2017-18 marketable debt levels declined alongside ad-hoc issuances of non-marketable securities linked to the BA financing. In the model, this is interpreted as a reallocation of debt from marketable to non-marketable components. Simple autoregressive processes are assumed for both θ_t and $restruct_t$:

$$\theta_t = \rho_\theta \theta_{t-1} + (1 - \rho_\theta)\theta^{ss} + \varepsilon_t^\theta \quad (52)$$

$$restruct_t = \rho_{restruct} restruct_{t-1} + \varepsilon_t^{restruct} \quad (53)$$

Debt service or interest expenditures are explicitly described for both marketable and non-marketable debt, with interest expenditures as a ratio to nominal GDP ($intcost_t^{j,rat}$) presented as follows:

$$intcost_t^{j,rat} = \frac{\left(\exp\left(\frac{i4_{t-1}^j}{400}\right) - 1\right) debt1y_{t-1}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-2}^j}{400}\right) - 1\right) debt1y_{t-2}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400}\right)} + \cdots$$

$$\frac{\left(\exp\left(\frac{i4_{t-3}^j}{400}\right) - 1\right) debt1y_{t-3}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400} + \frac{\Delta ny_{t-2}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-4}^j}{400}\right) - 1\right) debt1y_{t-4}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400} + \frac{\Delta ny_{t-2}}{400} + \frac{\Delta ny_{t-3}}{400}\right)} \tag{54}$$

where $i4^j$ denotes the 1-year interest rate on the j-type bond, and interest payments include all non-matured previous issuances.

The 1-year interest rate for marketable debt is defined by the term structure of interest rates:

$$i4_t^m = E_t\left(\frac{rs_t + rs_{t+1} + rs_{t+2} + rs_{t+3}}{4} + tprem_t^m\right) \tag{55}$$

where $tprem^m$ is the marketable debt term premium. Non-marketable interest rates are assumed to be fixed by the authorities at a constant (and relatively low) rate, adjusted for a term premium:

$$i4_t^{nm} = \left(i4^{nm,ss} + tprem_t^{nm}\right) \tag{56}$$

Term premia reflect investors' risk perception and are determined by the financial markets, capturing the mechanism whereby investors demand higher returns on government bonds when the debt levels are high relative to the target, and vice-versa:

$$tprem_t^j = \rho_{tprem} tprem_{t-1}^j + \left(1 - \rho_{tprem}\right)\left[tprem^{j,ss} + c_1^{tprem}(debt_t^{rat} - debt^{rat,tar})\right] + \varepsilon_t^{tprem^j} \tag{57}$$

The two coefficients (ρ_{tprem} and c_1^{tprem}) are assumed to be identical across the two debt components, however these can be easily specified as being different.

Figure 10 captures the schematic representation of the fiscal and money blocks in AMPM.

Figure 10: Schematic representation of monetary-fiscal interactions

4. Model Properties and Results

4.1 Model Calibration

In semi-structural economic modeling for practical central bank policy analysis and forecasting, calibrating model parameters is often preferred to estimation due to practical considerations and data limitations. Calibration uses existing empirical evidence and theoretical insights to set parameter values directly, ensuring the model aligns closely with observed economic phenomena and intuition. This approach is particularly advantageous for complex models where estimation might be computationally intensive or infeasible due to data limitations.

Moreover, calibration provides a transparent and controlled method for incorporating expert knowledge and empirical findings into the model. Unlike estimation, which relies heavily on statistical techniques and assumptions, calibration integrates known parameter values from empirical research or theoretical benchmarks. This is especially useful when certain parameters are difficult to estimate accurately due to variability and noise in economic data or lack of statistical identification. Macroeconomic data samples are often short (even for Bayesian estimation, in which case the posterior distributions would be driven excessively by the priors), contaminated by statistical breaks and/or affected by changes in policy regimes. Calibration ensures the model reflects realistic economic conditions and behaviors, improving its predictive power and policy relevance.

For AMPM, the calibration reflects the stylized facts of the Algerian economy (Section 2) and results from an iterative process of repeatedly testing various parameter values in terms of model properties (as described in the following subsections). In this context, calibration facilitated sensitivity analysis and allowed systematic exploration of how changes in calibrated parameters affect model outcomes. Annex C presents the calibrated values for model parameters.

4.1 Impulse Responses

Impulse response functions (IRFs) are essential for analyzing and validating structural macroeconomic models. They illustrate how endogenous variables, including the response in policy instruments, react to a temporary structural shock, holding other factors constant. The IRFs provide both qualitative (direction) and quantitative (magnitude) insights into the transmission mechanisms embedded within the model.

Figure 11 presents the IRFs to a 10 percent increase in global (real) price of energy, including both oil and gas, in one quarter. This leads to an expansion in extractive sector output in Algeria and a significant improvement in the current account balance, appreciating the dinar. The increase in extractive output has an indirect positive impact on non-extractive sector activities. Higher hydrocarbon exports revenues improve the current account position and allow to boost fiscal spending, resulting in above-trend structural fiscal deficits, consistent with historical cyclical government expenditure behavior in response to commodity price fluctuations.

Commodity price shocks affect price dynamics through the inflationary aggregate demand (domestic costs) channel slightly outweighing the deflationary pass-through from an overvalued exchange rate (import costs). Consequently, CPI inflation, as well as both core and non-core components, increase marginally, with headline annual inflation rising close to 0.2 percentage points above the steady state. Note that the magnitude of the pass-through effect is quite low: CPI inflation increases by maximum 0.2 percentage points for a 10 percent energy price shock. This aligns with Algeria's observed weak pass-through of global energy price shocks into

domestic prices, given its position of major fuel exporter where the government regulates domestic energy prices.

Figure 11: Global energy price shock (deviations from steady state)
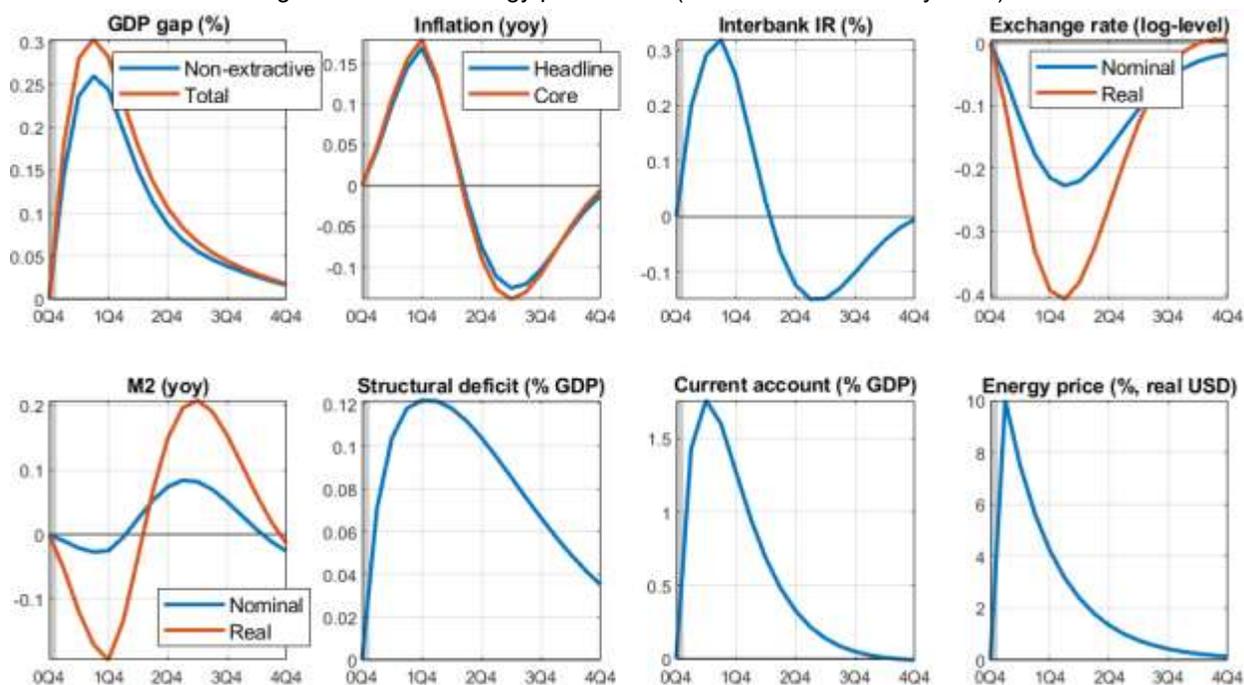
To stabilize the economy in the face of the terms of trade shock, the BA adopts a more depreciated nominal exchange rate reference value due to real overvaluation, limited by mild above-target inflation. However, the actual nominal exchange rate still appreciates due to significant current account-related influences and, to a lesser extent, due to higher interest rates. The latter is driven by the BA implementing a tighter M2 stance since both inflation (expectations) and output are above their equilibria, indicating the energy price increase acts as a demand shock for fuel exporting countries. These measures lead to tighter monetary conditions, primarily through higher interest rates, to curb above-trend dynamics in the non-extractive sector and bring core inflation back to the target. Medium-term fluctuations in certain variables' responses are typical in models approximating a monetary targeting regime with multiple policy objectives, resulting in volatile interbank interest rate dynamics, as seen in Musil et al. (2018) for Belarus.

Figure 12 illustrates the effects of a positive (expansionary) shock to domestic non-extractive sector output. Reflecting the volatility in sectoral GDP data, the shock has a short-lived impact on non-extractive output. Higher demand increases domestic prices and imports, worsening the current account balance and creating nominal depreciation pressures. However, the real exchange rate becomes slightly overvalued due to higher domestic inflation and only marginal nominal depreciation. In terms of fiscal developments, the countercyclical response involves running lower structural deficits (given above-trend output) and reducing the debt ratio, which is also driven by the improvement in nominal GDP following the demand shock.

BA's policy response includes lowering M2 growth below the target—as both inflation and output are above their equilibrium values—and adopting a tighter interest rate stance. For the nominal exchange rate, given the overvalued real exchange rate and slightly above-target inflation, BA sets the reference value toward more depreciated levels.

Figure 12: Domestic non-extractive sector demand shock (deviations from steady state)
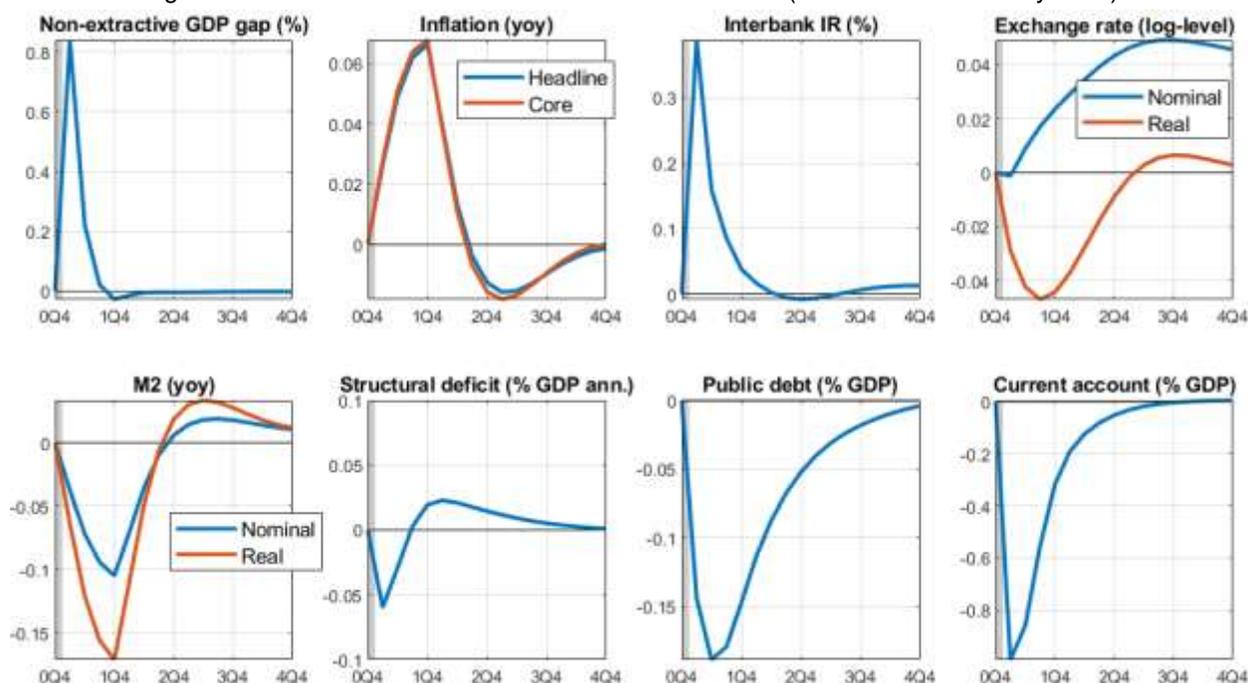
Figure 13 shows the effects of an unexpected cost push shock in core prices. Higher core inflation partially spills over into the non-core sector due to relative prices effects, leading to a moderate increase in headline CPI and real exchange rate overvaluation. Above-target inflation necessitates a tighter monetary policy stance, with M2 growth reduced below target in the short term. Consequently, interest rates rise and, combined with real exchange rate overvaluation, monetary conditions become restrictive. The resulting decline in non-extractive output helps to lower price pressures and restore price stability.

In line with canonical macroeconomic theory, cost push shocks present a tradeoff for monetary authorities. In the current specification and calibration of AMPM, which approximates the existing monetary policy framework prioritizing price stability, the central bank responds by tightening the money supply, leading to demand contraction. This active response to supply shocks, prioritizing inflation's return to target, is common in most QPMs, especially those designed for emerging market and developing economies (EMDEs). In contexts with a limited historical record of successfully maintaining price stability and fragile central bank credibility—factors that increase the risk of unanchored inflation expectations—monetary policy may need to focus on price stability even at the cost of output losses (see e.g., Abradu-Otoo et al., 2024).

While sluggish economic activity and reduced fiscal deficits improve the trade balance through lower import demand, the current account GDP ratio worsens due to significant price effects from real exchange rate appreciation. In terms of fiscal policy, lower non-extractive activity necessitates countercyclical fiscal support. However, the fiscal reaction indicates lower structural deficits, as significant interest rate costs (resulting from M2 tightening) push the debt ratio upward, threatening debt sustainability. In the short run, the nominal exchange rate remains stable. Depreciation pressures from higher debt and a worsening current account position are counterbalanced by a higher interest rate differential and above-target inflation, leading the BA to adopt more appreciated reference values.

Figure 13: Core prices shock (deviations from steady state)
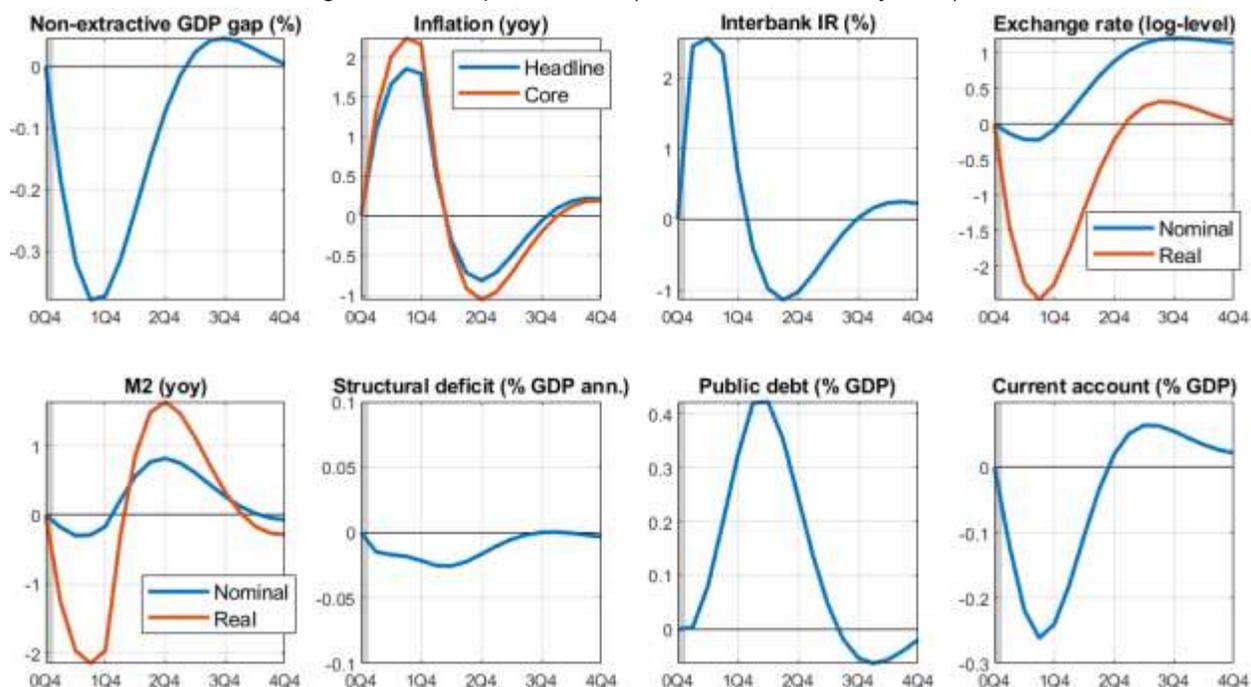

Figure 14 presents the effects of an unexpected fiscal expansion, modeled as a 1 percent of GDP increase in the structural deficit over four quarters. The higher deficits result in positive fiscal impulses, directly impacting non-extractive output, which increases by about 0.4 percent by the end of the first year.

Figure 14: Fiscal expansion shocks (deviations from steady state)
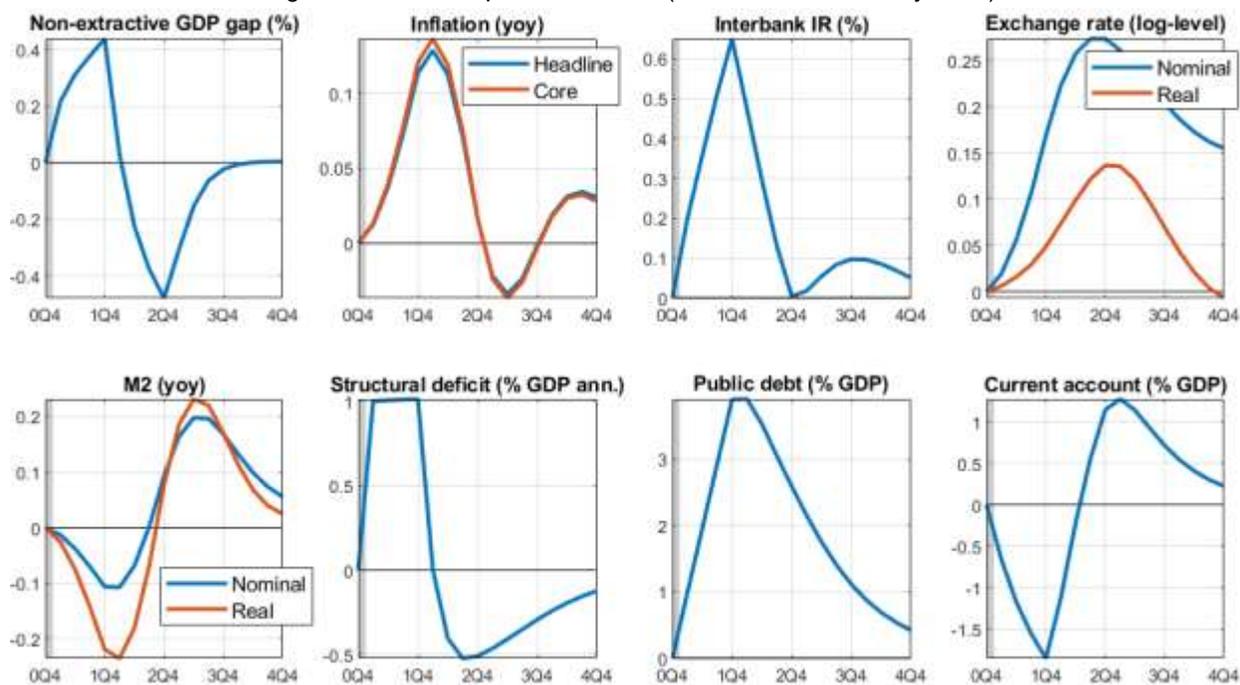
Higher demand leads to price pressures, with headline inflation rising due to both core and non-core segments (with core prices increasing relatively more, according to the specification and calibration of AMPM). In addition, more dynamic domestic economic activity and fiscal spending boost import demand, worsening the current account balance and exerting depreciation pressures. These are further amplified by increased risk aversion due to the rise in public debt needed to finance the fiscal expansion. The fiscal expansion simulation reflects aggregate demand-type effects, prompting the central bank to adopt a tighter M2 stance and increase interbank rates. This reduces domestic demand-side price pressures and restores macroeconomic stability. For BA's nominal exchange rate policy, a more appreciated reference value is indicated, due to slight real undervaluation and above-target inflation. This limits the actual nominal exchange rate depreciation and helps contain the pass-through of imported costs into domestic prices. The simulation suggests a reversal of fiscal policy starting in the second year, primarily due to significantly increased public debt ratio and debt sustainability concerns, necessitating a period of tighter fiscal policy. This behavior reflects the observed medium-term fluctuations in most variables.

Figure 15: Exchange rate depreciation shock (deviations from steady state)
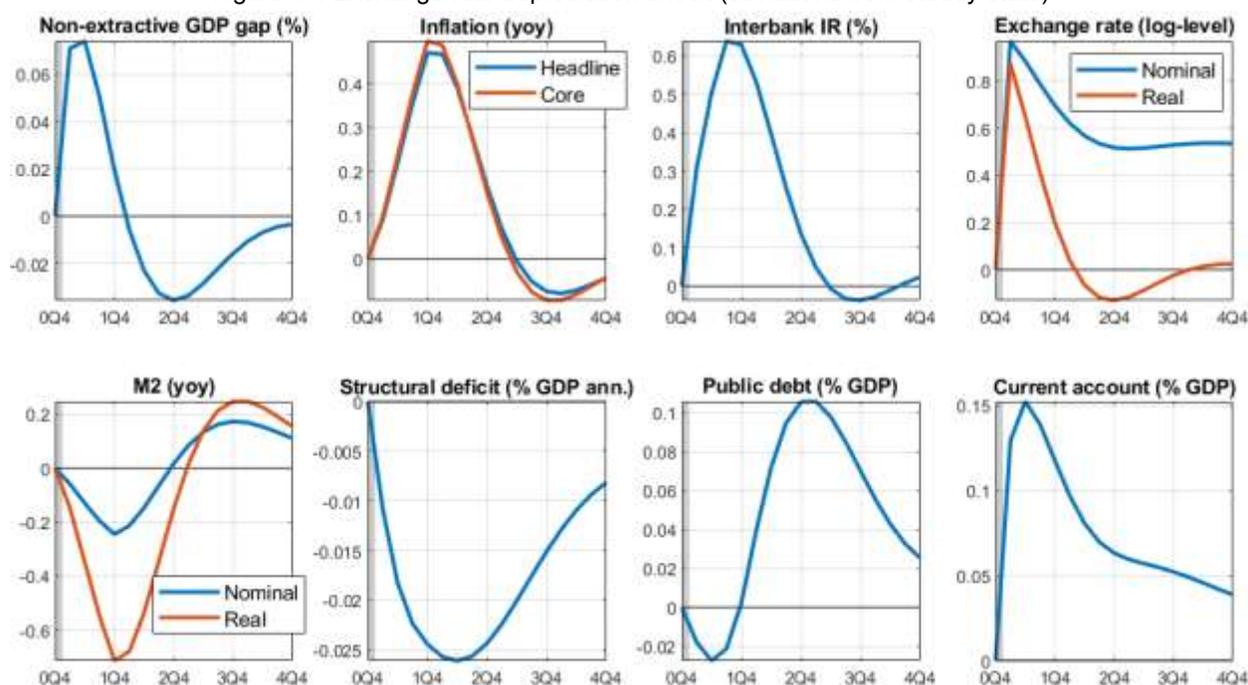
Figure 15 illustrates the effects of nominal exchange rate depreciation pressures, such as those arising from an unexpected but temporary reassessment of the domestic currency's value. A weaker dinar leads to additional imported cost pressures, generating inflationary effects. The undervalued exchange rate strengthens the current account position, with positive spillovers on non-extractive industries,[16] resulting in domestic demand-side inflationary pressures. Given both above-trend output and above-target core inflation, the BA reduces the M2 growth rate to tighten the interest rate stance and create more restrictive monetary conditions. Fiscal policy complements monetary policy by acting countercyclically, reducing the structural deficit, and generating negative fiscal impulses. The nominal exchange rate stabilizes at the new level around two years after the

---

[16] In general, semi-structural gap models, such as AMPM, incorporate the assumption that depreciation shocks are expansionary, driven by a favorable net exports channel, whereby an undervalued real exchange rate enhances price competitiveness. However, this contrasts with an alternative identification of depreciation shocks arising, for example, from capital outflows or risk-off pressures, particularly in emerging markets and developing economies with open capital accounts, which are more likely to have a contractionary effect. For further discussions, see Berg et al. (2023).

shock, partly due to a more appreciated reference value set by the BA in reaction to the initially weaker real exchange rate and above-target inflation.

4.3 Model-Based Historical Interpretations

Using observed data and Kalman filtration, model-based historical interpretation provides a macroeconomic narrative that explains the developments in key macroeconomic variables over time. This approach highlights driving forces behind historical trends and evaluates model specification, calibration, and performance. Kalman filtration decomposes observed variables into unobserved components (gaps and trends) and identifies structural shocks. These findings are cross-referenced with Algerian historical developments, offering insights into driving forces and transmission channels, including the effects of monetary policy actions, fiscal policy stance, inflationary pressures, and external position. The economic narrative is framed through the main blocks of AMPM, emphasizing unobserved variables. It provides a comprehensive analysis of the main drivers of Algerian macroeconomic developments from 2003Q1 to 2024Q4.

Economic Activity in Extractive and Non-extractive Sectors

Although the direct contribution of the extractive sector to economic growth based on National Accounts data is not dominant (Figure 16, left panel[17]), it remains a critical driver of the Algerian economy in terms of both internal and external balance. This sector significantly influences aggregate real economic activity, particularly exports and fiscal policy, shaping overall macroeconomic developments.

Figure 16: Real GDP growth and output gap
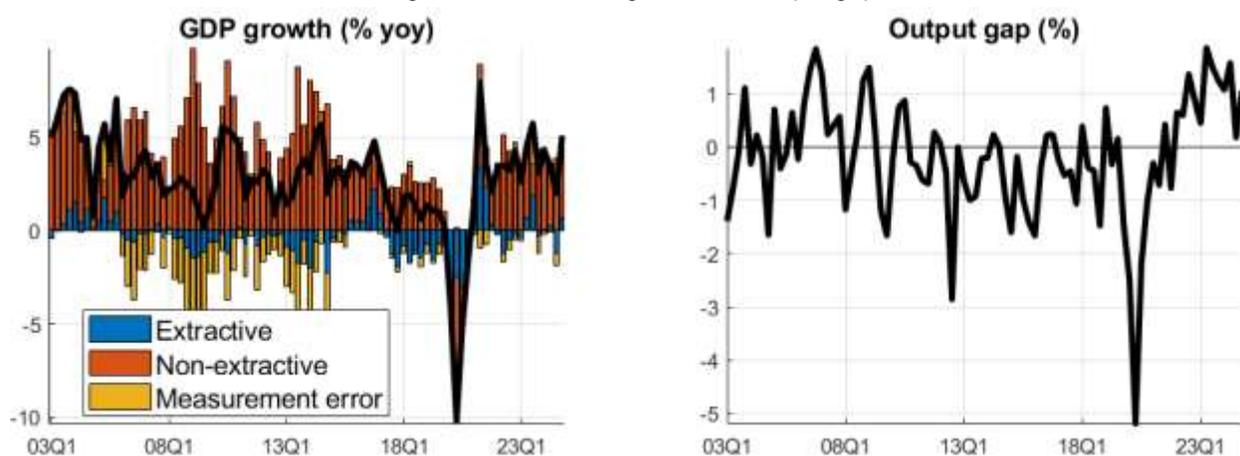
Over the past decades, Algeria has experienced distinct growth periods revealed by contraction and recovery phases of the business cycle, with the output gap (Figure 16, right panel) also reflecting the high volatility of GDP data given estimated smooth trend series. Before the global financial crisis, economic growth was characterized by a gradually declining tendency, while the output gap was neutral on average. This suggests that demand-driven inflationary pressures remained subdued, since the output gap derived from AMPM serves as a proxy for such price pressures. Between 2010 and 2019, economic growth slowed further, averaging around 2.8 percent, and dipped to around 2 percent just before the COVID-19 pandemic. This deceleration was accompanied by a slowing potential growth. The COVID-19 pandemic caused a severe economic contraction, driven by declines in both extractive and non-extractive sectors, resulting in a significantly negative output gap.

---

[17] Note that this section presents model-based decompositions, so that the annual GDP growth rate breakdown features a measurement error driven primarily by the assumed constant sectoral shares, in line with equation (1).

However, post-2020 the Algerian economy rebounded strongly, supported by the recovery in both sectors. This resurgence restored pre-pandemic consumption levels and generated inflationary pressures through a positive output gap.

For analytical purposes, aggregate economic activity and output gap in AMPM are divided into extractive and non-extractive sectors, thus better capturing the dynamics and the distinct impacts of these sectors on the economy. Following the global financial crisis, extractive sector output exhibited a clear downward trend (Figure 17, left panel), reflecting its declining contribution to overall economic activity. The output gap in the extractive sector has closely tracked fluctuations in oil and gas prices, global demand for these commodities, and Algerian extraction capacities (Figure 17, right panel). It turned negative during the global commodity price declines between 2013 and 2016 and during the COVID-19 pandemic. These negative output gaps indicate periods of underutilized capacity in the extractive sector, driven by adverse external conditions and structural challenges within the Algerian economy.

Figure 17: Extractive GDP and extractive output gap
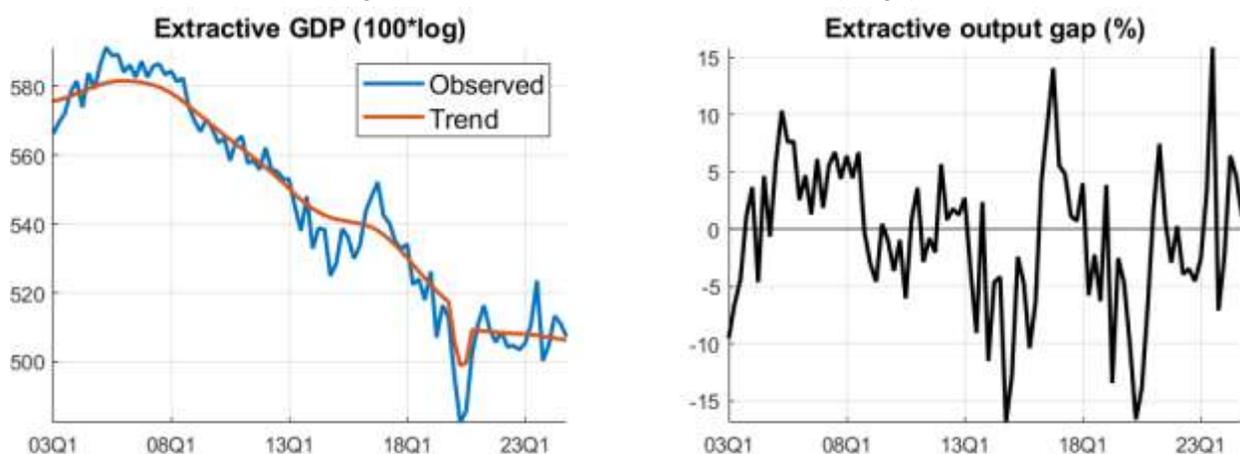
Non-extractive GDP—comprising services, industry, construction and agriculture—has been growing continuously over the past 20 years, except during the pandemic crisis (Figure 18, left panel). During this period, actual and potential output growth significantly declined, as the identification of the unobserved potential output reflects the imposition of state-mandated restrictions on economic activity. However, the Algerian economy has recovered and gradually renewed its robust growth, reaching about 4 percent on average after 2021.

The non-extractive output gap, a key driver of domestic inflationary pressures, is presented in Figure 18 (right panel), along with its breakdown (third panel). Early in the analyzed period, trade balance (TB) gap and fiscal policy were the primary drivers, with fiscal policy remaining relatively restrictive between 2003 and 2008 (given the contractionary fiscal impulses estimated for this period, consistent with fiscal surpluses, even in the context of exceptionally high government expenditures). Post-2013, fiscal policy shifted to a largely expansionary stance, driven by successive large fiscal deficits in the context of lower oil and gas prices.

The effect of monetary policy is captured through real interest rate (RIR) and real exchange rate (RER) gaps, which together comprise the monetary conditions index. When output gap was negative in 2015-18 and during the COVID-19 pandemic, monetary policy adopted an expansionary stance via these two channels (although relatively later in the second episode, i.e., starting 2021 only). Throughout other periods, monetary policy

remained broadly neutral or impacted the economy primarily via the real exchange rate, highlighting the importance of and reliance on international trade for Algeria's economic activity. In addition, the significance of Algeria's integration into the international trade in goods and services is captured via the trade balance gap contributions to the non-extractive output gap. It plays a pivotal role over the analyzed sample, with prominent negative contributions to the domestic business cycle in 2015-17, in the context of the global slump in energy prices, as well as during the COVID-19 period. Conversely, post-pandemic improvements in the trade balance (returning to surpluses), alongside proactive fiscal and monetary policies, have driven economic overheating.

The relatively high contributions of demand shocks during the COVID-19 crisis and in recent years have been linked primarily to private consumption behavior and investment activity that are not fully captured in the current AMPM structure. The volatility of the non-extractive output gap highlights low persistence, as reflected in the relatively small value of the lag parameter in the IS curve ($b_1^{yne} = 0.4$) compared to benchmark models. Moreover, the relatively small contribution of monetary policy through both real exchange rates and real interest rates indicates a weak transmission of monetary policy to non-extractive economic activity and thus to inflation, with other factors playing a relatively more significant role.

Figure 18: Non-extractive GDP, non-extractive output gap and its decomposition
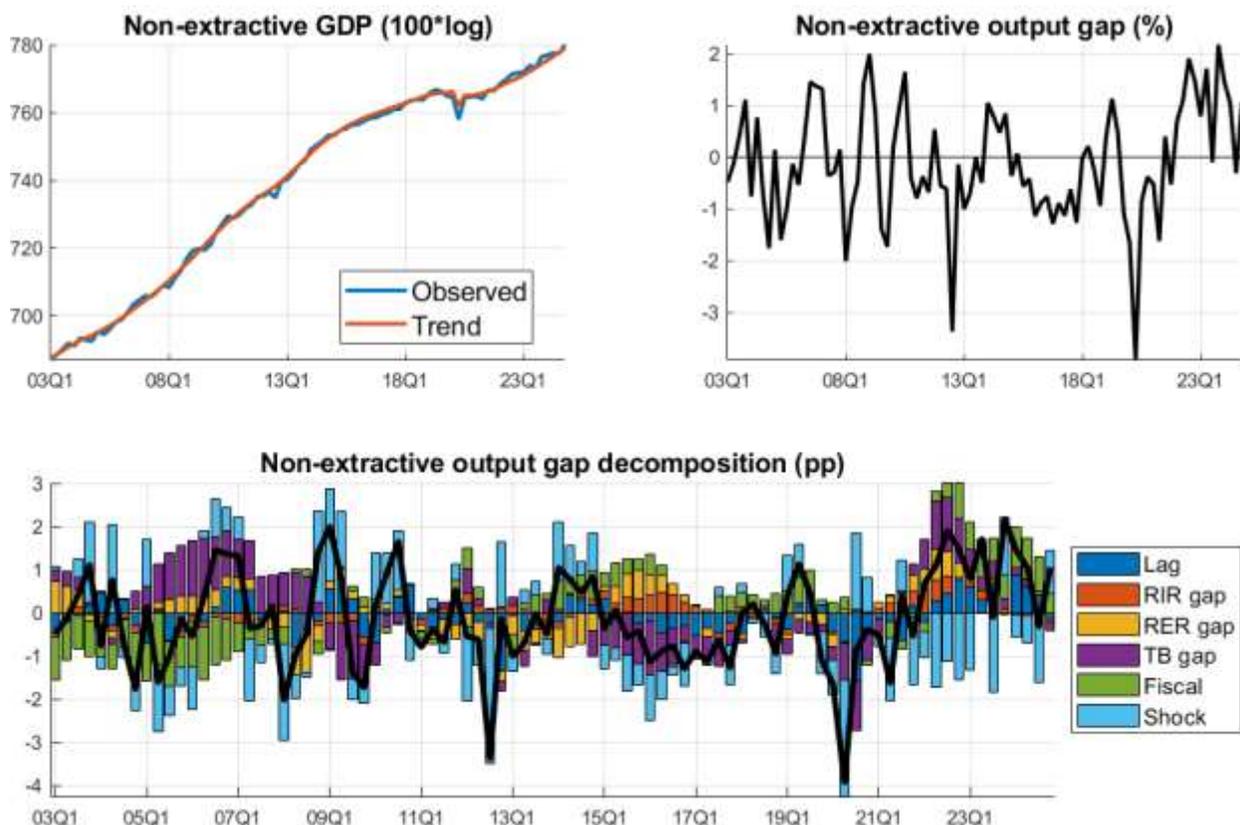
Balance of Payments and External Balance

The Algerian economy relies heavily on international trade, with oil and gas exports playing a crucial role. Hydrocarbon exports are critical for shaping government revenues, foreign exchange reserves, and exchange rate dynamics. As illustrated in Figure 19, the key components of Algeria's balance of payments (as shares of nominal GDP) are the trade balance position of the current account and the official reserves financing

component of the financial account. Other items in the balance of payments (for both the current account and the financial account) are relatively minor and are treated as residuals in the context of balance of payments accounting employed in AMPM.

Figure 19: Balance of payment decompositions
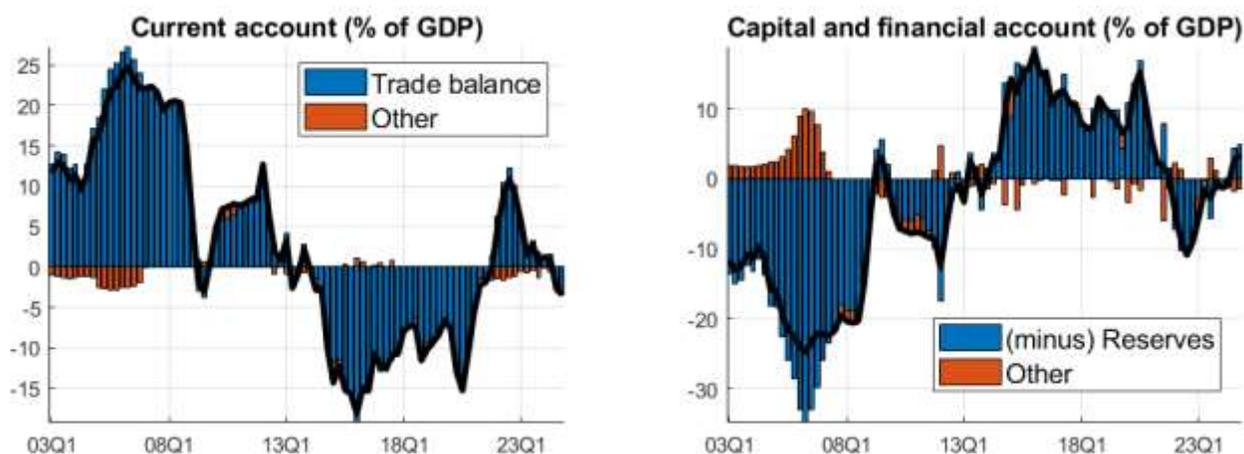
While the trade balance exhibits significant volatility, its general trend reveals a decade of surpluses pre-2013 transitioning into deficits thereafter, with recent stabilization around a relatively balanced position. Figure 20 highlights this trend (top panel), alongside a decomposition of the trade balance gap (bottom panel), accounting for both export and import determinants as described in equation (23). Global energy prices and extractive production drive natural resources exports, while foreign demand influences (albeit with an overall marginal effect) non-hydrocarbon exports, reflecting Algeria's position in international trade. On the imports side, non-extractive output gap and fiscal deficit are key determinants, capturing import demand from both private and public sectors. Both export and import sides are also affected by the RER gap, reflecting international price competitiveness, market share, and import price substitution effects. Other factors are captured through shocks.

The decomposition confirms the dominant effects of hydrocarbon exports (both through real oil prices and the extractive output gap) and the heavy dependence of imports on domestic demand, including government acquisitions. Consistent with the stylized facts, the low share of non-hydrocarbon exports (Figure 7 in Section 2) and the limited impact of foreign competitiveness are evident in the minimal contributions of the foreign demand gap and the RER gap to trade balance dynamics.

Before the 2008 global financial crisis, Algeria's economy benefited from a trade balance surplus, primarily driven by strong commodity exports, improved competitiveness (reflected in an undervalued real exchange rate), and an overheated global economic environment (high foreign demand). However, the financial crisis disrupted this favorable situation, as plummeting oil prices significantly reduced export revenues, leading to trade deficits and a negative TB gap. In the subsequent years, the situation stabilized temporarily. However, starting in mid-2014 and until the pre-COVID period, the TB gap turned negative due to declining oil and gas exports amid globally depressed commodity prices. Weak non-extractive domestic demand and a temporarily undervalued real exchange rate somewhat mitigated the deterioration in net exports. Nonetheless, persistent oil price shocks and the COVID-19 pandemic disturbances further exacerbated trade deficits, leading to a sharp decline in foreign reserves.

Figure 20: Trade balance trend and gap decomposition

Trade balance (% of GDP)

Trade balance gap decomposition (pp)
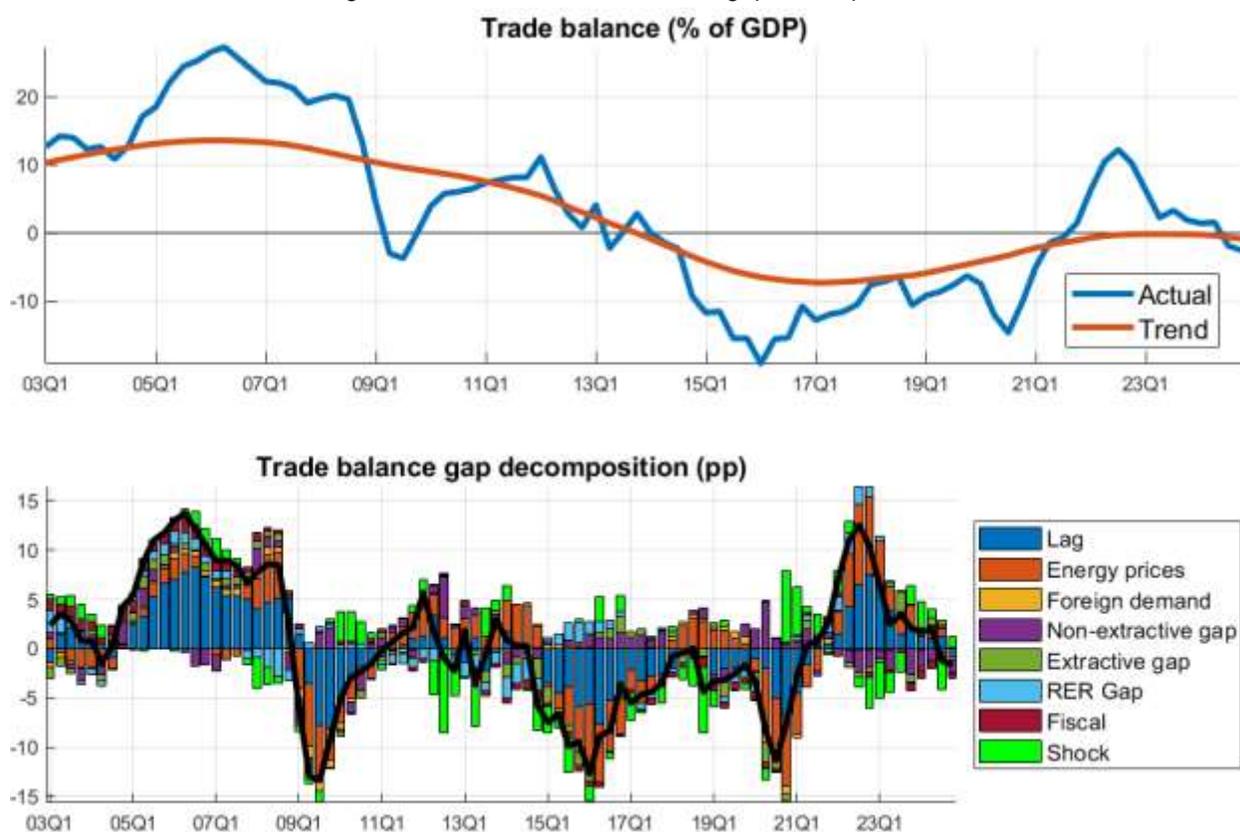
Trade balance improved post-2021, driven primarily by higher oil prices and, to a lesser extent, a recovery in non-hydrocarbon exports. This improvement in the external position contributed significantly to the overall economic recovery. By 2023, the trade balance trend has stabilized close to zero and the gap balanced, signaling progress toward external stability. Despite ongoing diversification efforts, the extractive industries remain critical for the Algerian economy.

Fiscal Policy and Government Debt

Fiscal policy, heavily influenced by the extractive sector and associated export revenues, plays a pivotal role in driving the real economy. The government debt-to-GDP ratio, which remained relatively stable at around 7 percent after the global financial crisis, began to rise steadily in 2015. It climbed continuously, peaking at close to 60 percent before recently stabilizing below 50 percent (Figure 21, left panel). This increase, captured primarily by non-marketable debt instruments (Figure 3 in Section 2), reflects a persistent rise in government deficits. Consistent with the dynamics of the debt-to-GDP ratio, the model-estimated unobserved (implicit) debt target has evolved upwards over time.

Government debt dynamics largely mirror the high volatility of oil revenues, the long-term decline in real extractive GDP, and the rising trajectory of current public expenditures.[18] The latter began to rise significantly

---

[18] The fiscal block in AMPM does not provide a decomposition into revenue and expenditure side. These are handled via satellite calculations and thus not discussed here.

after 2015. A breakdown of the headline deficit into primary deficits and interest payments reveals that interest costs have remained relatively low, reflecting the non-marketable nature of the debt (see Section 2).

Figure 21: Government debt and fiscal deficit
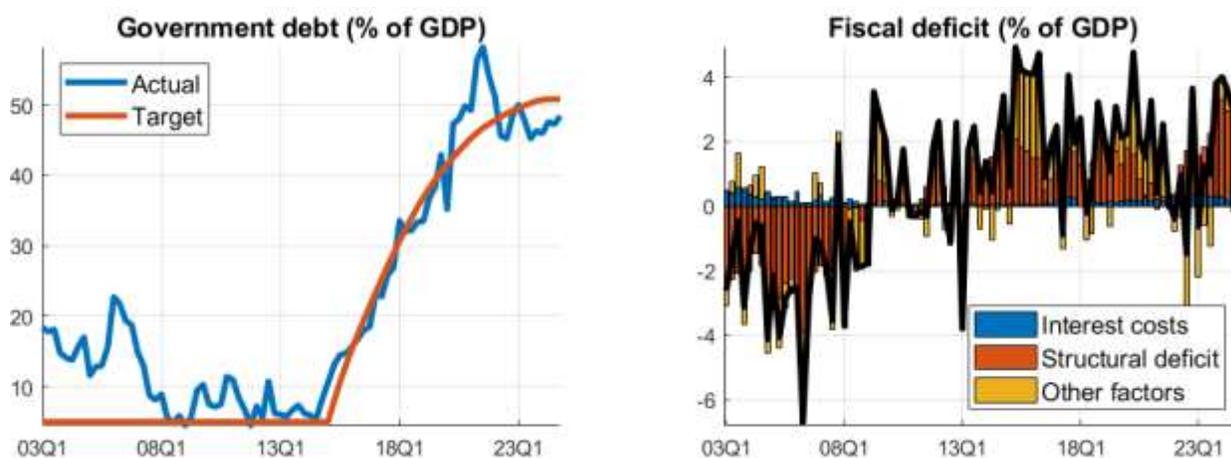
The structural deficit, representing the cyclically adjusted primary deficit, provides insight into the underlying stance of fiscal policy. As illustrated in Figure 21 (right panel), the structural deficit has generally followed the trajectory of government debt, with some exceptions. This close relationship reinforces the narrative that fiscal policy has been fundamentally shaped by structural factors in the economy.

The structural fiscal deficit reflects the government's underlying fiscal position and serves as a measure of the fiscal policy impact on aggregate demand, particularly in relation to the non-extractive output gap, as specified in equation (3). It is closely tied to changes in structural deficits, highlighting their interconnected dynamics in the case of Algeria. This relationship, observed on an annual frequency, is illustrated in Figure 22. Rising deficits in response to adverse economic shocks indicate countercyclical fiscal policy behavior, evident during certain periods. However, in other years, Algerian fiscal policy has exhibited more pro-cyclical tendencies. This fiscal approach underscores the challenges of maintaining consistent countercyclical fiscal management in an economy heavily reliant on volatile hydrocarbon revenues.

Figure 22: Fiscal impulse
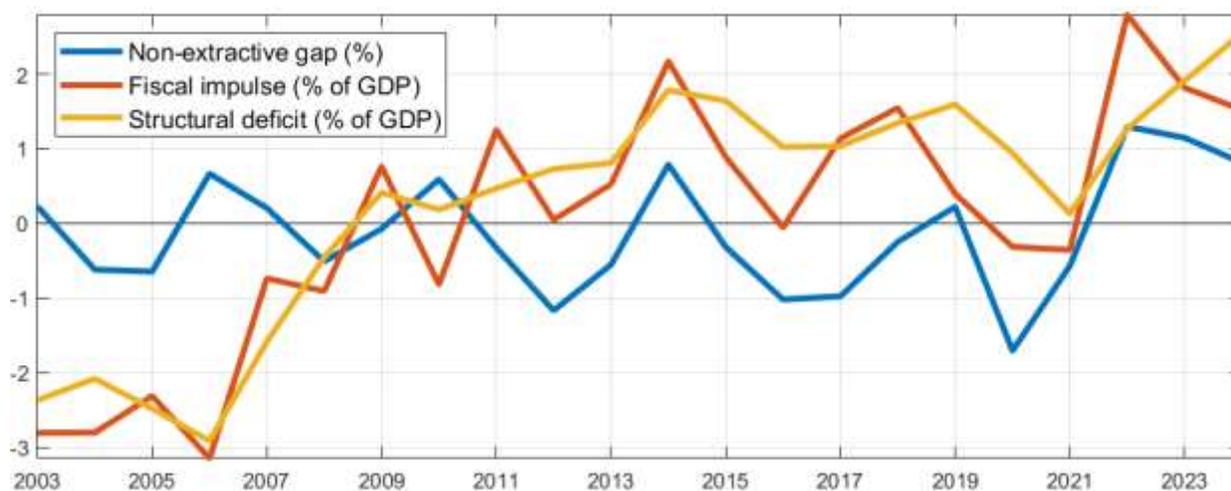
Monetary Policy: Money Targeting and Exchange Rate

The BA influences real economic activity and inflation by affecting monetary conditions relevant for economic agents. Assessing the monetary policy stance requires understanding the key components of the monetary conditions, such as the real interest rate gap and the real exchange rate gap. Their impact on the non-extractive output gap is illustrated in Figure 17.

The trend real interest rate is shaped by several factors, including foreign real interest rate trend, the country risk premium, and the expected appreciation trend of the real exchange rate. The real exchange rate trend follows a pattern typical for developing countries, reflecting an appreciation tendency before the late-2010s global financial crisis, followed by a period of real depreciation. A negative real interest rate gap and/or a positive real exchange rate gap (indicating undervaluation) signal stimulative conditions that expand real economic activity and generate inflationary pressures. Figure 23 depicts these trends alongside their respective gaps.

In many cases, the real exchange rate has been driven by nominal depreciation of the Algerian dinar against the US dollar (see Figure 4 in Section 2). Since 2003, the dinar experienced several episodes of depreciation pressures, primarily driven by the fluctuations in global energy prices (Figure 25). Notable nominal depreciations occurred in 2009 and 2015, coinciding with sharp declines in oil prices due to reduced global demand for commodities and overproduction. Conversely, favorable commodity price trends have bolstered the Algerian currency; for instance, in 2023 the dinar appreciated by nearly 5 percent, supported by a recovery in hydrocarbon prices and current account surpluses.

The real interest rate and its gap (deviation from trend) provide insight into the relative accommodativeness of monetary policy, as shown in Figure 23. A below-trend real interest rate—resulting in a negative real interest rate gap and suggesting expansionary monetary policy stance, with positive impact on non-extractive output gap—was particularly evident during 2014–17, a period characterized by gradual nominal interbank rate reductions, as well as during the COVID-19 pandemic, when monetary easing aimed to counter adverse pandemic effects and support economic activity.

Figure 23: Real interest rate and real exchange rate
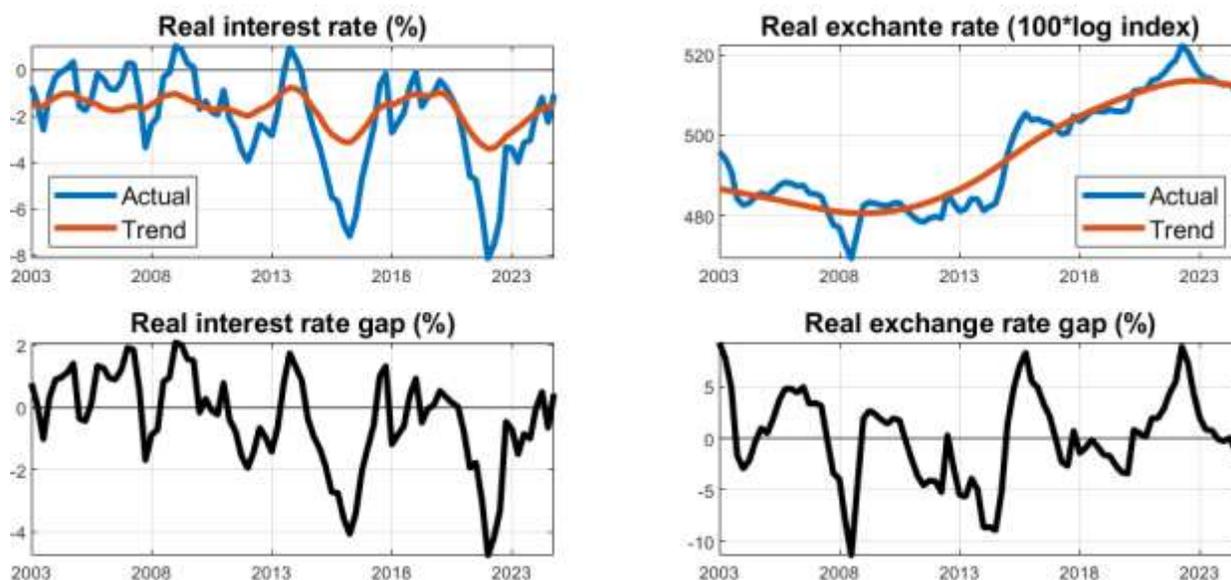
Money supply growth (M2) follows a reaction function determined by the BA, specified in equation (31). This policy reaction function reflects historical patterns and aligns with the Bank's objectives. Monetary policy seeks to restore equilibrium by primarily responding to expected deviation of annual core inflation from the target. It also considers the business cycle position of the economy, as indicated by the non-extractive output gap term, and the misalignment between actual M2 growth and its target. Furthermore, money supply growth is guided by long-term economic fundamentals, aiming to reduce short-term volatility by smoothing M2 growth rates dynamics. By adjusting M2 growth, monetary policy influences the interbank interest rates, achieving a proper monetary stance via the real interest rate (i.e., nominal interest rate adjusted for inflation expectations) and setting money growth in line with the desired sterilization of foreign exchange flows. Figure 24 provides a decomposition of quarterly money supply growth, illustrating the relative importance of these factors and instances where monetary policy deviated from the systematic reaction, captured as shocks.

Figure 24: Money supply growth
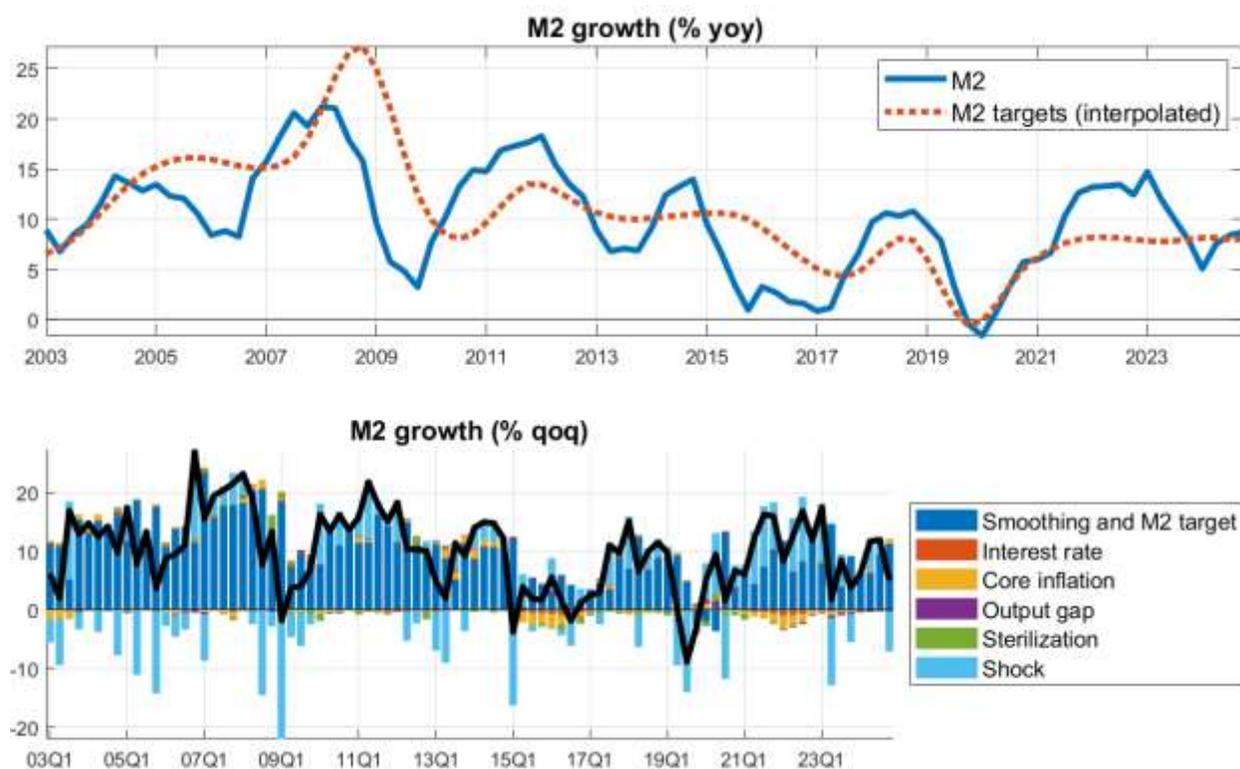
The actual money supply growth has exhibited significant volatility, influenced by exogenous factors and efforts to meet BA's year-end money growth targets. In line with historical cross-country experience, money targets in de jure monetary targeting regimes often imperfectly signal the direction of monetary policy rather than serve as a nominal anchor, thus being implemented less rigidly and with frequent misses in practice, blurring the policy stance assessment. In BA's case, M2 growth targets are set explicitly or implicitly, and are considered exogenous for the QPM and complemented by intra-year money growth targets determined by the model. These align with the country's broader economic fundamentals and exhibit a relatively high degree of smoothness. From the decomposition of the money supply reaction function, the dominant factor influencing actual money growth is the smoothing mechanism, capturing the central bank's tendency to adjust policy instruments gradually over time, rather than making large or abrupt changes in response to economic conditions. Additionally, the BA also visibly reacts to expected deviations of inflation from its objective. Despite

these systematic elements, relatively frequent and important deviations from the reaction function are identified throughout the historical sample.

The monetary policy block of the model also provides insights into the nominal exchange rate dynamics, reflecting the Bank of Algeria's managed floating regime, primarily aimed at aligning the real effective exchange rate with its medium-term equilibrium. The impact of capital flows is minimal and existing regulations requiring exporters to convert their FX receipts into dinar with the central bank give the BA a quasi-monopolistic position on the FX market. Accordingly, AMPM assumes that the Bank sets the reference exchange rate following a nominal exchange rate rule. The policy-defined exchange rate path is consistent with the primary goal to eliminate exchange rate misalignments, align the exchange rate with long-term economic fundamentals, and reduce short-term volatility, as formalized in equation (40).

Figure 25 shows that the actual nominal exchange rate has experienced relatively high volatility, largely driven by fluctuating commodity prices and other exogenous factors (nominal exchange rate shocks). The decomposition of the exchange rate rule illustrates how the BA adjusts the exchange rate policy primarily in response to real exchange rate misalignments while avoiding excessive volatility. It also highlights some contributions from expected inflation deviations, ensuring alignment with the Bank's primary objective of price stability. Additionally, the small contributions of exchange rate policy shocks highlight the occasional deviations from the rule, when necessary, such as those caused by oil price fluctuations or large changes in government spending.

Figure 25: Nominal exchange rate
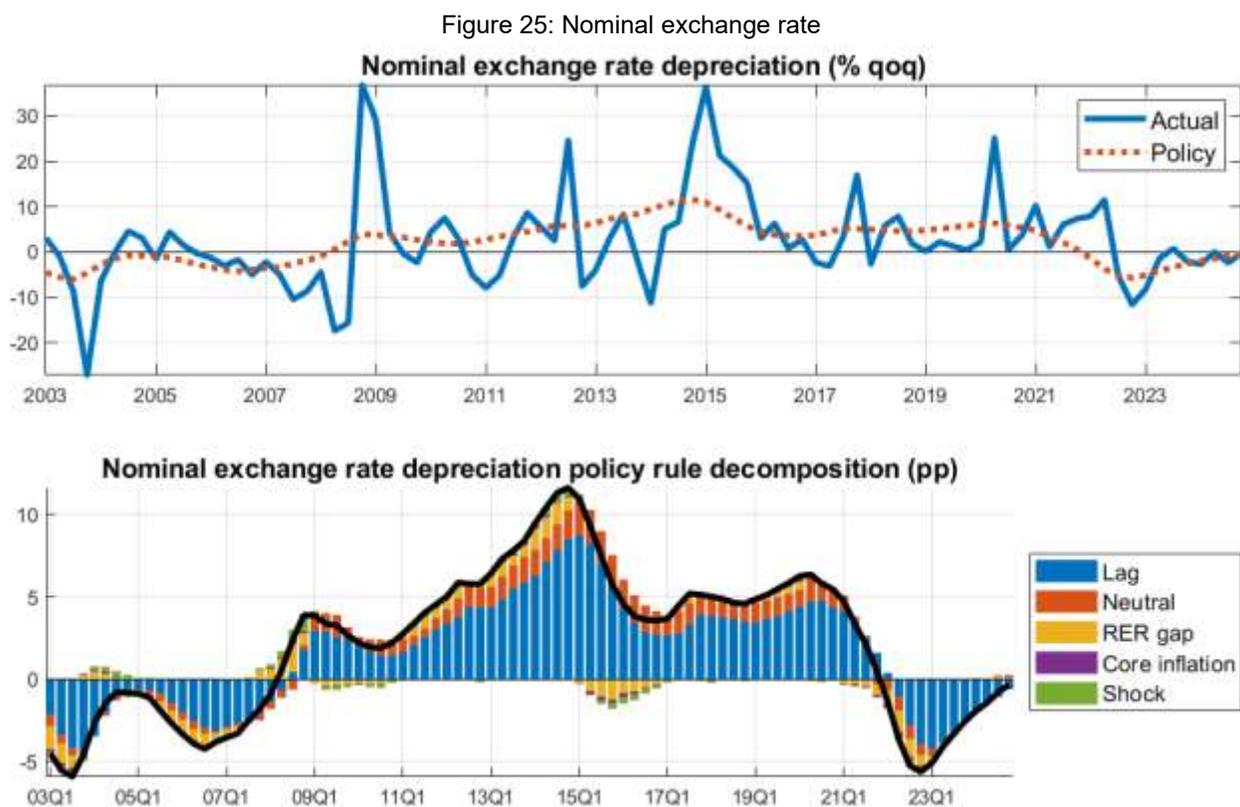
Inflation

As mentioned above, the BA prioritizes core inflation, which represents 83 percent of the consumption basket and excludes volatile fresh food prices, aiming for a medium-term core inflation rate of 4 percent. Figure 26 illustrates annual headline inflation (with core and non-core breakdown) and core price dynamics. During 2003-05 inflation remained relatively low, averaging around 4 percent. However, inflationary pressures began to rise in 2006, peaking in 2009 due to sharp increases in fresh food prices. Inflation surged again in 2012, reaching 9 percent, driven by rising food and manufactured goods prices, and excess liquidity from elevated public spending. After a brief period of low inflation in late 2013 and early 2014, inflation rose again in 2015, spurred by higher import prices and a 34 percent dinar depreciation. Inflation surged to 6.4 percent in 2016, before moderating somewhat, with pressures subsiding by 2019.

During the initial COVID-19 pandemic disturbances, inflation dropped to 2.4 percent, reflecting a moderation in core inflation and declining non-core prices. However, inflation accelerated significantly between 2021 and 2023, exceeding 9 percent at its peak. This surge was driven by drought conditions, base effects, global supply chain disruptions, and heightened post-pandemic demand. Recent inflationary pressures appear to be primarily short-term (rather than indicative of structural changes in the economy), as non-core prices, such as fresh vegetables, have risen faster than core prices, indicating the likely transitory nature of recent inflation dynamics. Consistent with this, core inflation evolved close to or below the 4 percent target during 2024.

Figure 26: Headline and core inflation
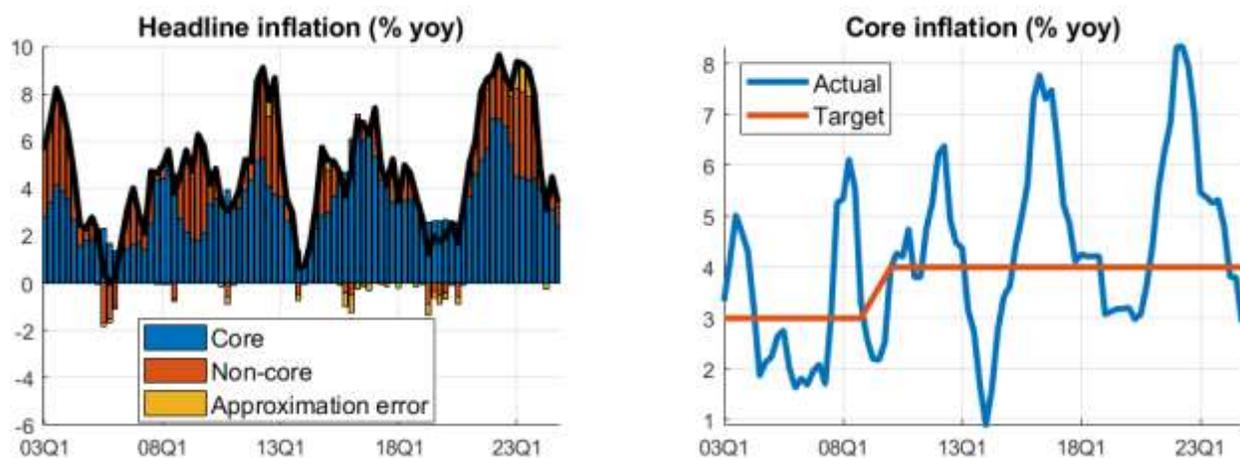
The driving forces behind core inflation, as discussed earlier, are confirmed by the model-based decomposition of real marginal costs. The positive association suggests that when core-specific real marginal costs are relatively high, inflationary pressures rise, leading to an increase in core inflation, and vice versa (Figure 27, left panel).

Figure 27 (right panel) decomposes the real marginal costs of core inflation into three key factors: domestic demand (approximated by the non-extractive output gap), foreign price effects (captured through the real exchange rate gap), and global commodity (oil and gas) prices. Foreign prices and energy prices have been the primary drivers of real marginal cost variability, and thus core inflation fluctuations. This aligns with Algeria's high dependence on key trading partners for imported intermediate and final goods, with a meaningful pass-through of the associated costs into domestic core inflation. The trajectory of real marginal costs shows significant inflationary pressures in 2005-06, 2015-16, and 2022-23, primarily driven by real exchange rate

movements. These pressures were followed by increases in core inflation, reflecting underlying inflationary trends in the domestic economy.

Figure 27: Core inflation and real marginal costs
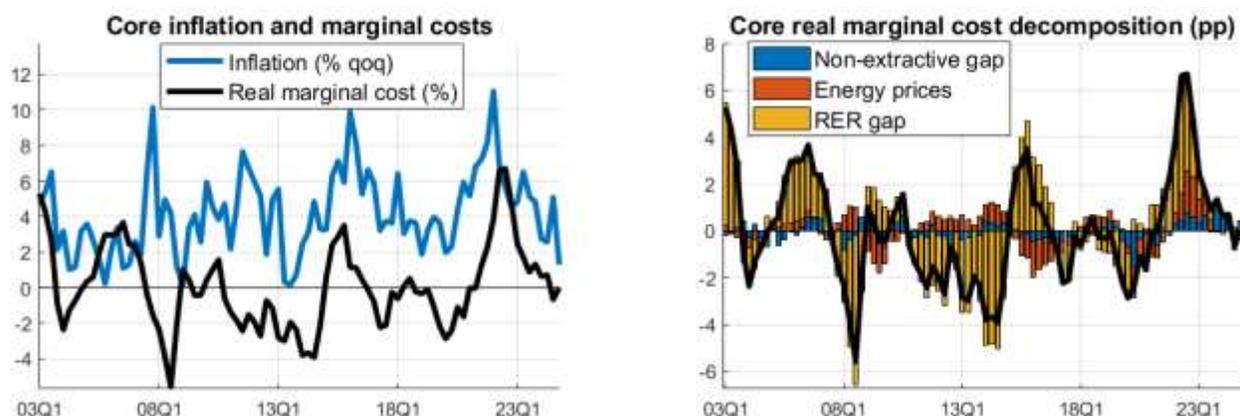
4.4 In-Sample Simulations

In-sample simulations serve as another tool for evaluating model performance and data fit. In-sample recursive forecasts are constructed conditionally on foreign variables (e.g., foreign economic indicators, oil and gas prices) and domestic targets (i.e., inflation and money growth targets). This approach assumes perfect foresight of these variables, excluding historical revisions and both domestic trends and expert judgments (essential components of regular forecasting exercises). Recursive projections, spanning eight quarters ahead and originating at each point in time from 2010Q1 to 2024Q3, are compared against observed data to evaluate their alignment with actual tendencies, turning points and potential biases. Results indicate that the forecast simulations for main macroeconomic variables closely follow observed data, particularly the nominal exchange rate, a critical variable for the BA's monetary policy conduct. The QPM-based simulations show no systematic deviations, with forecast errors remaining relatively small (in absolute value) and balanced over the simulation horizon in terms of direction.

Figure 28 illustrates the in-sample simulations for six key domestic macroeconomic variables, covering the period 2010-24 (the last quarter in the case of real GDP represents a nowcast). The six variables are: real GDP annual growth, reflecting real economic activity; headline annual inflation rate, capturing price developments; DZD/USD nominal exchange rate and M2 money growth, key monetary policy variables; current account deficit, highlighting reliance on natural resource exports and high openness to international trade; and public debt, reflecting fiscal impact as modeled endogenously.

Real GDP grew slightly below 5 percent on average over the sample period, driven by extractive and non-extractive sectors. The QPM predicts non-extractive growth relatively well, but the hydrocarbon sector introduces variability and biases, particularly between 2016 and 2020, due to significant commodity market volatility. AMPM does not fully capture the pandemic-induced downturn and the subsequent recovery, which is expected given the complex and unexpected nature of these shocks. The model-based *headline inflation* forecasts are slightly more volatile compared to actual data. This discrepancy arises because inflation forecasts are derived from core inflation and the rest of the CPI basket (fresh food). The latter exhibits higher forecast errors, suggesting that integrating an exogenous outlook for this subcomponent could improve the overall inflation data fit.

Figure 28: In-sample simulations
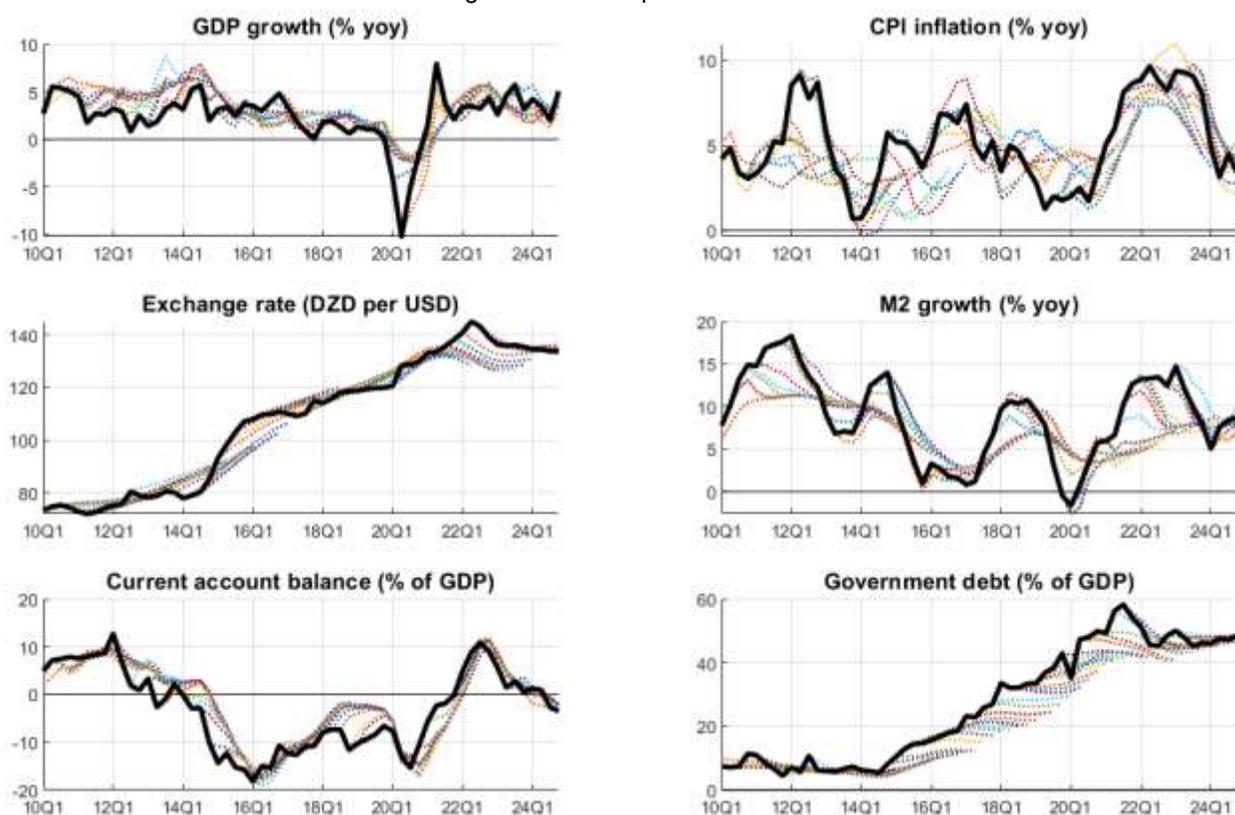
Model-based simulations perform well for the two *policy variables*, especially the nominal exchange rate. *Exchange rate* forecasts align closely with actual data, except during extraordinary depreciation events in 2015 and 2022. Simulated *M2 money growth* is generally in line with observed data, reflecting a smoothing effect consistent with the policy reaction function and convergence to the implicit money growth targets.

The model effectively replicates *current account* dynamics. The forecasts are able to capture the deteriorating current account starting 2012, the gradual improvement starting in 2016, and especially the marked recovery in 2021-22. Finally, the *government debt* forecasts, generated endogenously by the fiscal block, are also unbiased, showing no systematic or persistent deviations from the observed data.

The model fit is numerically evaluated using RMSE (root mean squared error) statistics and compared against the random walk (RW) benchmark; see Table 1. A ratio below 1 indicates that AMPM outperforms the RW model for the given forecast horizon. As expected, RMSEs increase as the forecast horizon extends. However, AMPM consistently outperforms the RW model for all variables across all horizons. Notably, for variables such as the nominal exchange rate, current account ratio, and debt ratio, the RMSE relative to the RW model declines further into the future, highlighting the usefulness of AMPM for medium-term forecasts. For inflation and money growth, the ratio remains broadly stable.

While important validation tests have been conducted, such as impulse response functions, historical equation decompositions, and in-sample simulations, ongoing work aims to further enhance the accuracy and reliability of QPM-based forecasts and the BA's FPAS with regular ex-post (out-of-sample) evaluations and decompositions of forecast changes. Ex-post evaluations compare actual historical forecasts with realized data

to identify biases and improve forecast approaches, while the decomposition of forecast changes helps understand the factors driving forecast adjustments round-by-round and ensures robust policy advice.

Table 1: RMSE and RMSE relative to the random walk (RW) model

AMPM RMSE

	1-q	2-q	3-q	4-q	5-q	6-q	7-q	8-q
GDP growth (% yoy)	1.44	1.85	2.04	2.33	2.42	2.44	2.35	2.31
CPI inflation (% yoy)	0.92	1.42	1.76	2.23	2.21	2.20	2.15	2.12
Exchange rate (DZD per USD)	2.01	3.16	3.94	4.51	4.87	5.06	5.11	5.13
M2 growth (% yoy)	1.20	2.11	2.98	3.74	3.87	3.91	3.87	3.79
Current account balance (% of GDP)	2.77	3.50	3.88	4.05	4.12	4.17	4.18	4.21
Government debt (% of GDP)	2.59	3.17	3.87	4.38	5.05	5.73	6.49	7.29

AMPM RMSE relative to RW RMSE

	1-q	2-q	3-q	4-q	5-q	6-q	7-q	8-q
GDP growth (% yoy)	0.68	0.62	0.61	0.62	0.66	0.70	0.65	0.63
CPI inflation (% yoy)	0.68	0.70	0.67	0.70	0.64	0.61	0.57	0.56
Exchange rate (DZD per USD)	0.80	0.73	0.66	0.60	0.55	0.50	0.46	0.42
M2 growth (% yoy)	0.55	0.57	0.60	0.63	0.59	0.56	0.53	0.52
Current account balance (% of GDP)	0.93	0.77	0.69	0.63	0.57	0.52	0.48	0.44
Government debt (% of GDP)	0.82	0.78	0.74	0.75	0.74	0.75	0.76	0.76

5. Conclusion

The Banque d'Algérie (BA) is modernizing its monetary policy framework with IMF technical assistance (TA), developing a Forecasting and Policy Analysis System (FPAS) centered on Algeria Macroeconomic Projection Model (AMPM). This advanced analytical framework supports forward-looking policymaking at the BA by accurately capturing key features of the Algerian economy, including the monetary-fiscal policy landscape, the managed floating exchange rate arrangement, and exposure to global energy price fluctuations.

Built on a New-Keynesian semi-structural trend-gap framework, AMPM incorporates core domestic blocks and an exogenous external block. It disaggregates real GDP into extractive and non-extractive components, emphasizing the hydrocarbon sector's importance for aggregate economic activity. The model decomposes the CPI into core and non-core components to understand sectoral price dynamics and interlinkages, with implications for monetary policy. It also addresses fiscal sector dynamics driven by global energy prices, considering fiscal balance and domestic public debt, decomposed into marketable and non-marketable components. The balance of payments block represents the current account and capital and financial account, with the trade balance driven primarily by oil and gas exports.

In terms of economic policies, the model specifies a forward-looking monetary policy reaction function for money supply (M2). The BA uses various instruments to achieve price stability, with broad money supply as the main intermediate target. Additionally, the BA assumes an active exchange rate policy, guiding the nominal exchange rate to close real exchange rate deviations from the medium-run trend. The fiscal block anchors public debt accumulation through a fiscal reaction function for the structural deficit. The external balance

incorporates relevant balance of payments positions, including current account dynamics heavily impacted by hydrocarbon exports, changes in reserve-related financing in the absence of large private financial flows, and corresponding FX reserves accumulation.

The comprehensive structure of AMPM captures key features and interactions within the economy, thus providing a robust tool for policy analysis and forecasting in support of the decision-making process. It incorporates relevant elements, such as weak policy transmission due to shallow financial markets and the dominance of terms of trade and supply shocks, allowing to simulate different policy scenarios to inform policymakers about the implications of various monetary strategies, and to conduct regular macroeconomic projections.

In assessing and validating AMPM, IRFs illustrate how endogenous variables react to temporary structural shocks, providing insights into the model's transmission mechanisms. The findings point out that the responses generally align with the expected theoretical consistency, demonstrating the model's robustness in capturing key economic interlinkages and policy responses. For instance, the IRFs show that an increase in global energy prices leads to an expansion in the extractive sector, positive spillovers to non-extractive activities, an improved current account balance, and dinar appreciation, consistent with expectations that higher energy prices boost domestic economic activity and export revenues, which tend to strengthen the currency. Similarly, a fiscal expansion increases non-extractive output and price pressures, prompting the BA to adopt a tighter M2 stance, which aligns with the theoretical response to demand-driven inflationary pressures.

Model-based historical interpretations using observed data and Kalman filtration provide a comprehensive narrative of Algeria's recent macroeconomic developments. They highlight key drivers behind historical evolutions and assess the model's specification, calibration, and theoretical consistency. The model offers valuable insights into transmission channels and the effects of monetary policy actions, fiscal policy stance, inflationary pressures, and external position. These findings are cross-referenced with historical data and stylized facts to ensure accuracy and relevance.

Despite its strengths, AMPM faced challenges in accurately capturing certain dynamics, such as the pandemic-induced downturn and subsequent recovery, and exhibited volatility in inflation forecasts. Integrating an exogenous outlook for fresh food prices could enhance headline inflation accuracy. Additionally, the model showed some limitations in terms of hydrocarbon sector forecasts due to global commodity market volatility. Nonetheless, AMPM remains a robust tool for policy analysis, offering valuable and consistent insights into Algeria's economic structure and outlook under different scenarios.

AMPM described in this working paper reflects main theoretical and empirical findings at the time of publication. Its operational use by the BA staff during regular forecasting rounds involves the incorporation of complementary assessments and judgments, ensuring model's relevance and performance. While AMPM captures the current key features of the economy and policy framework, it can be effectively adapted to policymakers' demands, both under the existing regime and a prospective modernized one. Complementing the development of AMPM, ongoing efforts are channeled towards building and strengthening other FPAS elements and processes. This includes internal communications among relevant BA departments to ensure fully consistent analytical work in support of the policy processes and regular interactions with BA's decision-making body, as well as enriching external communications to support forward-looking policy formulation.

References

Abradu-Otoo, P., Acquah, J., K., Attuquaye, J., Harvey, S., K., Loloh, F., Mkhatrishvili, S., Nalban, V., Ngoh, D., Osei, V. & Quansah, M. (2024) Quarterly Projection Model for the Bank of Ghana: Extensions and Applications. IMF Working Papers 24/237.

Al-Sharkas, A., Al-Azzam, N., AlTalafha, S., Abu Shawish, R., Shalein, A., Rawwaqah, A., Al-Rawashdeh, A., Baksa, D., Karam, P. & Vlcek, J. (2023). An Extended Quarterly Projection Model for the Central Bank of Jordan. IMF Working Papers 23/172.

Bank of Algeria (2022). Inflation dynamics and determinants in Algeria: An empirical investigation. BA Working Paper 1-2022.

Bank of Algeria (2025). Rapport Annuel 2024. Evolution Economique et Monétaire.

Berg, A., Karam, P. D. & Laxton, D. (2006). A Practical Model-Based Approach to Monetary Policy Analysis – Overview. IMF Working Papers 06/80.

Berg, A., Hul, Y., Karam, P. D., Remo A. & Rodriguez Guzman, D. (2023). FINEX – A New Workhorse Model for Macroeconomic Forecasting and Policy Analysis. IMF Working Papers 23/235.

Chinn, M. & Ito, H. (2008). A New Measure of Financial Openness. Journal of Comparative Policy Analysis 10(3): 309 - 322.

Dakila Jr., F. G., Bautista, D. M., Dacio, J. E., Amodia, R. A., Castañares, S. J. A., Alhambra, P. R. R., Marquez, C. J. P., Ocampo, J. C. G., Romaraog, M. R. S., Karam, P., Baksa, D. & Vlcek J. (2024). A Monetary and Financial Policy Analysis and Forecasting Model for the Philippines (PAMPh2.0). IMF Working Papers 24/148.

International Monetary Fund (2015a). Evolving Monetary Policy Frameworks in Low-Income and Other Developing Countries. IMF Policy Papers.

International Monetary Fund (2015b). Evolving Monetary Policy Frameworks in Low-Income and Other Developing Countries – Background Paper: Country Experiences. IMF Policy Papers.

International Monetary Fund (2016). Algeria: Selected Issues. IMF Country Report No. 16/128.

International Monetary Fund (2017). Algeria: Selected Issues. IMF Country Report No. 17/142.

International Monetary Fund (2024). Algeria: 2023 Article IV Consultation. IMF Country Report No. 24/88.

International Monetary Fund (2025a). Algeria: 2025 Article IV Consultation. IMF Country Report No. 25/270.

International Monetary Fund (2025b). Algeria: Selected Issues. IMF Country Report No. 25/271.

Mæhle, N., Hlédik, T., Selander, C. & Pranovich M. (2021). Taking Stock of IMF Capacity Development on Monetary Policy Forecasting and Policy Analysis Systems. IMF Departmental Papers DP/2021/026.

Mehibel, S. & Belarbi, Y. (2017). Inflation Dynamics in Algeria. Journal of Economics and Behavioral Studies 9(6).

Musil, K., Pranovich, M. & Vlcek, J. (2018). Structural Quarterly Projections Model for Belarus. IMF Working Papers 18/254.

Nalban, V. & Zanna, L. F. (2025). QPM-Based Analysis of Weather Shocks and Monetary Policy in Developing Countries. IMF Working Papers 25/95.

Unsal, F., Papageorgiou, C. & Garbers, H. (2022). Monetary Policy Frameworks: An Index and New Evidence. IMF Working Papers 22/22.

Appendix A. Model Variables

Real Aggregate Demand		
Code	**Name**	**Unit**
GDP		
y_t	GDP: Real volume	100*log
$\hat{y}_t$	GDP: Gap	% deviation from its trend
$\bar{y}_t$	GDP: Trend	100*log
Δy_t	GDP: Real volume growth	%, QoQ annualized
$\Delta \bar{y}_t$	GDP: Trend growth	%, QoQ annualized
Extractive GDP		
y_t^e	Extractive GDP: Real volume	100*log
$\hat{y}_t^e$	Extractive GDP: Gap	% deviations from its trend
$\bar{y}_t^e$	Extractive GDP: Trend	100*log
Δy_t^e	Extractive GDP: Real volume growth	%, QoQ annualized
$\Delta \bar{y}_t^e$	Extractive GDP: Trend growth	%, QoQ annualized
Non-extractive GDP		
y_t^{ne}	Non-extractive GDP: Real volume	100*log
$\hat{y}_t^{ne}$	Non-extractive GDP: Gap	% deviations from its trend
$\bar{y}_t^{ne}$	Non-extractive GDP: Trend	100*log
Δy_t^{ne}	Non-extractive GDP: Real volume growth	%, QoQ annualized
$\Delta \bar{y}_t^{ne}$	Non-extractive GDP: Trend growth	%, QoQ annualized
Non-extractive nominal GDP		
ny_t^{ne}	Non-extractive nominal GDP: Level	100*log
$\widehat{ny}_t^{ne}$	Non-extractive nominal GDP: Gap	% deviation from its trend
$\overline{ny}_t^{ne}$	Non-extractive nominal GDP: Trend	100*log
Δny_t^{ne}	Non-extractive nominal GDP: Growth	%, QoQ annualized
$\Delta \overline{ny}_t^{ne}$	Non-extractive nominal GDP: Trend	%, QoQ annualized
$defl_t$	Non-extractive GDP deflator	100*log
rd_t	Relative price of deflator: Index	100*log
$\widehat{rd}_t$	Relative price of deflator: Gap	% deviation from its trend
$\overline{rd}_t$	Relative price of deflator: Trend	100*log
$\Delta \overline{rd}_t$	Relative price of deflator: Trend growth	%, QoQ annualized

Aggregate Supply		
Code	Name	Unit
CPI: core, non-core and deflator		
p_t	CPI: Index	100*log
π_t	CPI: Quarterly inflation	%, QoQ annualized
π_t^4	CPI: Annual inflation	%, YoY
p_t^c	Core: Index	100*log
π_t^c	Core: Quarterly inflation	%, QoQ annualized
$\pi_t^{4,c}$	Core: Annual inflation	%, YoY
rmc_t^c	Real marginal cost: Core	%
p_t^{nc}	Non-core: Index	100*log
π_t^{nc}	Non-core: Quarterly inflation	%, QoQ annualized
$\pi_t^{4,nc}$	Non-core: Annual inflation	%, YoY
rmc_t^{nc}	Real marginal cost: Non-core	%
Relative prices		
rp_t	Relative price of core: Index	100*log
$\widehat{rp}_t$	Relative price of core: Gap	% deviation from its trend
$\overline{rp}_t$	Relative price of core: Trend	100*log
$\Delta\overline{rp}_t$	Relative price of core: Trend growth	%, QoQ annualized

Balance of Payments		
Code	Name	Unit
ca_t^{rat}	Current account	% of nominal GDP
$\overline{ca}_t^{rat}$	Current account: Trend	% of nominal GDP trend
$\widehat{ca}_t^{rat}$	Current account: Gap	% deviation from its trend
tb_t^{rat}	Trade balance	% of nominal GDP
$\bar{tb}_t^{rat}$	Trade balance: Trend	% of nominal GDP trend
$\widehat{tb}_t^{rat}$	Trade balance: Gap	% deviation from its trend
$ca_t^{other,rat}$	Other current account items: Actual	% of nominal GDP
kfa_t^{rat}	Financial account inflows	% of nominal GDP
$kfanonres_t^{rat}$	Non-reserve financial inflows	% of nominal GDP
$resfin_t^{rat}$	FX Reserve accumulation	% of nominal GDP
nfa_t^{rat}	Total Net foreign assets	% of nominal GDP
res_t^{rat}	FX-reserves stock	% of nominal GDP
$nfa_t^{priv,rat}$	Private net foreign assets	% of nominal GDP

Monetary Policy and Exchange Rate		
Code	Name	Unit
z_t	Real exchange rate (USD): Index	100*log
$\hat{z}_t$	Real exchange rate (USD): Gap	% deviation from its trend
$\bar{z}_t$	Real exchange rate (USD): Trend	100*log
$\Delta\bar{z}_t$	Real exchange rate (USD): Trend growth	%, QoQ annualized
$\pi_t^{4,tar}$	Core CPI target	%, YoY
m_t	Nominal money (M2)	100*log

Δm_t	Nominal money growth	%, QoQ annualized
m_t^{tar}	Nominal money target	100*log
Δm_t^{tar}	Nominal money growth quarterly target	%, QoQ annualized
$\Delta^4 m_t^{tar}$	Nominal money growth annual target	%, YoY
rm_t	Real money: Index	100*log
$\widehat{rm}_t$	Real money: Gap	% deviation from its trend
$\overline{rm}_t$	Real money: Trend	100*log
rm_t^{tar}	Real money target	100*log
$\Delta\overline{rm}_t$	Real money trend growth	%, QoQ annualized
Δv_t	Money velocity growth	%, QoQ annualized
rs_t	Nominal interbank interest rate	%
$rs_t^{neutral}$	Nominal neutral interest rate	%
r_t	Real interest rate: Actual	%
$\hat{r}_t$	Real interest rate: Gap	%
$\bar{r}_t$	Real interest rate: Trend	%
$prem_t$	Country risk premium	%
s_t	Nominal exchange rate (DZD/USD)	100*log
Δs_t^{pol}	Nominal exchange rate policy depreciation rate	%, QoQ annualized
Δs_t^{tar}	Nominal exchange rate target depreciation rate	%, QoQ annualized

Fiscal Sector		
Code	**Name**	**Unit**
$intcost_t^{rat}$	Debt service: Total	% of nominal GDP
$intcost_t^{f,rat}$	Debt service: Foreign currency	% of nominal GDP
$intcost_t^{d,rat}$	Debt service: Domestic currency	% of nominal GDP
$intcost_t^{m,rat}$	Debt service: Marketable debt	% of nominal GDP
$intcost_t^{nm,rat}$	Debt service: Non-marketable debt	% of nominal GDP
$i4_t^m$	1-year marketable debt interest rate	%
$tprem_t^m$	1-year marketable debt term premium	%
$i4_t^{nm}$	1-year non-marketable debt interest rate	%
$tprem_t^{nm}$	1-year non-marketable debt term premium	%
$debt_t^{rat}$	Total public debt	% of nominal GDP
$debt_t^{rat,tar}$	Total public debt target	% of nominal GDP
$debt_t^{m,rat}$	Marketable public debt	% of nominal GDP
$debt_t^{nm,rat}$	Non-marketable public debt	% of nominal GDP
$debt1y_t^{m,rat}$	Newly issued 1-year marketable debt	% of nominal GDP
$debt1y_t^{nm,rat}$	Newly issued 1-year non-marketable debt	% of nominal GDP
def_t^{rat}	Government deficit: Total (headline)	% of nominal GDP
$pdef_t^{rat}$	Primary deficit: Total	% of nominal GDP
$pdef_t^{rat,struct}$	Primary deficit: Structural part	% of nominal GDP
$pdef_t^{rat,cyc}$	Primary deficit: Cyclical part	% of nominal GDP
$pdef_t^{rat,tar}$	Primary deficit: Target	% of nominal GDP

$\widehat{debt}_t^{rat}$	Debt deviation term	% deviation from target
θ_t	Local currency financing share	%
$fimp_t^{rat}$	Fiscal impulse	% of nominal GDP
$restruct_t$	Restructuring of outstanding debt stock	% of nominal GDP

Foreign Economies		
Code	**Name**	**Unit**
Relative prices: Commodities		
en_t	Energy price: Index, USD	100*log
zen_t	Real energy price: Index	100*log
$\widehat{zen}_t$	Real energy price: Gap	% deviation from its trend
$\overline{zen_t}$	Real energy price: Trend	100*log
$\Delta\overline{zen_t}$	Real energy price: Trend growth	%, QoQ annualized
US		
rs_t^{rw}	US Federal Funds rate	%
r_t^{rw}	US real interest rate	%
$\bar{r}_t^{rw}$	US real interest rate trend	%
p_t^{rw}	US CPI	100*log
π_t^{rw}	US inflation	% QoQ annualized
$\hat{y}_t^{rw}$	US output gap in USA	% of potential

Appendix B. Model Equations

B.1 Internal Balance

Real Economy and Aggregate Demand

GDP growth:

$$\Delta y_t = w_{y_e}\, \Delta y_t^e + \left(1 - w_{y_e}\right)\Delta y_t^{ne} + \varepsilon_t^y$$

Output gap:

$$\hat{y}_t = w_{y_e}\, \hat{y}_t^e + \left(1 - w_{y_e}\right)\hat{y}_t^{ne}$$

Non-extractive and extractive output gap:

$$\hat{y}_t^{ne} = b_1^{y_{ne}}\hat{y}_{t-1}^{ne} - b_2^{y_{ne}}mci_t + b_3^{y_{ne}}\widehat{tb}_t^{rat} + b_4^{y_{ne}}fisc_t + \varepsilon_t^{y_{ne}}$$

$$\hat{y}_t^e = c_1^{y_e}\hat{y}_{t-1}^e + c_2^{y_e}\widehat{zen}_t + \varepsilon_t^{y_e}$$

GDP trend growth:

$$\Delta\overline{y_t^e} = \rho_{\Delta y_e}\Delta\overline{y_{t-1}^e} + \left(1 - \rho_{\Delta y_e}\right)\Delta\overline{y_{ss}^e} + \varepsilon_t^{\Delta y_e}$$

$$\Delta\overline{y_t^{ne}} = \rho_{\Delta y_{ne}}\Delta\overline{y_{t-1}^{ne}} + \left(1 - \rho_{\Delta y_{ne}}\right)\Delta\overline{y_{ss}^{ne}} + \varepsilon_t^{\Delta y_{ne}}$$

Nominal non-extractive GDP and its growth:

$$ny_t^{ne} = y_t^{ne} + defl_t$$

$$\Delta\overline{ny_t^{ne}} = \rho_{\Delta ny_{ne}}\Delta\overline{ny_{t-1}^{ne}} + \left(1 - \rho_{\Delta ny_{ne}}\right)(\Delta\overline{y_{ss}^{ne}} + \pi_t^{4,tar} + \Delta\overline{rd}_t) + \varepsilon_t^{\Delta y_{ne}}$$

Relative price of deflator, its decomposition in trend and gap:

$$rd_t = defl_t - p_t^c$$

Trend and gap decomposition of deflator to core price CPI:

$$rd_t = \overline{rd}_t + \widehat{rd}_t$$

$$\Delta\overline{rd}_t = \rho\Delta\overline{rd}_{t-1} + (1-\rho)(\Delta\overline{ny_{ss}^{ne}} - \Delta\overline{y_{ss}^{ne}} - \pi_{ss}^{4,tar}) + \varepsilon_t^{\Delta\overline{rd}}$$

Inflation and Aggregate Supply

Headline CPI:

$$p_t = w_{p_c}\, p_t^c + (1 - w_{p_c})p_t^{nc} + disc_t^p$$

$$disc_t^p = disc_{t-1}^p + \varepsilon_t^p$$

Core inflation Phillips curve and real marginal costs:

$$\pi_t^c = c_1^{\pi_c}E_t\pi_{t+1}^c + (1 - c_1^{\pi_c})\pi_{t-1}^c + c_2^{\pi_c}rmc_t^c + \varepsilon_t^{\pi_c}$$

$$rmc_t^c = c_1^{rmc_c}\hat{y}_t^{ne} + c_2^{rmc_c}\widehat{zen}_t + (1 - c_1^{rmc_c} - c_2^{rmc_c})\hat{z}_t$$

Non-core (fresh food) Phillips curve and real marginal costs:

$$\pi_t^{nc} = c_1^{\pi_{nc}}E_t\pi_{t+1}^{nc} + (1 - c_1^{\pi_{nc}})\pi_{t-1}^{nc} + c_2^{\pi_{nc}}rmc_t^{nc} + \varepsilon_t^{\pi_{nc}}$$

$$rmc_t^{nc} = c_1^{rmc_{nc}}\hat{y}_t^{ne} + c_2^{rmc_{nc}}\widehat{zen}_t + (1 - c_1^{rmc_{nc}} - c_2^{rmc_{nc}})(\hat{z}_t + \widehat{rp}_t)$$

Relative price of core to non-core price CPI, its decomposition in trend and gap:

$$rp_t = p_t^c - p_t^{nc}$$

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

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

B.2 External Balance

Balance of payments identity:

$$ca_t^{rat} + kfa_t^{rat} = 0$$

Current account trend gap decomposition:

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

Current account:

$$ca_t^{rat} = tb_t^{rat} + ca_t^{other,rat}$$

Current account gap and trend:

$$\widehat{ca}_t^{rat} = \widehat{tb}_t^{rat}$$

$$\overline{ca}_t^{rat} = \overline{tb}_t^{rat} + \left(ca_t^{other,rat} - \varepsilon_t^{ca^{other,rat}}\right)$$

Trade balance trend and gap decomposition:

$$tb_t^{rat} = \widehat{tb}_t^{rat} + \overline{tb}_t^{rat}$$

$$\widehat{tb}_t^{rat} = c_1^{\widehat{tb}^{rat}}\widehat{tb}_{t-1}^{rat} + (1 - c_1^{tb^{rat}}) \cdot \ldots$$

$$\ldots\left(c_2^{tb^{rat}}\widehat{zen}_t + c_3^{tb^{rat}}\,\hat{y}_t^{rw} - c_4^{tb^{rat}}\hat{y}_t^{ne} + c_5^{tb^{rat}}\hat{y}_t^e + c_6^{tb^{rat}}\hat{z}_t - c_7^{tb^{rat}}(pdef_t^{rat,struct} - pdef_t^{rat,tar})\right) + \varepsilon_t^{\widehat{tb}^{rat}}$$

$$\overline{tb}_t^{rat} = c_1^{\overline{tb}^{rat}}\overline{tb}_{t-1}^{rat} + (1 - c_1^{\overline{tb}^{rat}})\left(\overline{tb}_{ss}^{rat} + c_2^{\overline{tb}^{rat}}(\Delta\overline{zen}_t - \Delta\overline{zen}_{ss})\right) + \varepsilon_t^{\overline{tb}^{rat}}$$

Other current account items:

$$ca_t^{other,rat} = c_1^{ca^{other,rat}}ca_{t-1}^{other,rat} + \left(1 - c_1^{ca^{other,rat}}\right)ca_{ss}^{other,rat} + \varepsilon_t^{ca^{other,rat}}$$

Financial account flows:

$$kfa_t^{rat} = kfanonres_t^{rat} - resfin_t^{rat}$$

Endogenous non-reserve financial inflows:

$$kfanonres_t^{rat} = c_1^{kfa^{nonres,rat}} kfanonres_{t-1}^{rat} + \left(1 - c_1^{kfa^{nonres,rat}}\right) kfanonres_{ss}^{rat} \ldots$$

$$\ldots + c_2^{kfa^{nonres,rat}}(prem_t - prem_{ss}) + \varepsilon_t^{kfanonres^{rat}}$$

Law of motion for FX reserves:

$$res_t^{rat} = \frac{resfin_t^{rat}}{4} + res_{t-1}^{rat} \frac{\left(1 + \frac{\Delta s_t}{400}\right)}{\left(1 + \frac{\Delta ny_t^{ne}}{400}\right)} + \varepsilon_t^{res^{rat}}$$

Total net foreign assets (nfa_t^{rat}):

$$nfa_t^{rat} = res_t^{rat} + nfa_t^{priv,rat}$$

B.3 Economic Policies

Monetary Policy

Money supply (M2) reaction function:

$$\Delta m_t = c_1^m \Delta m_{t-1} + (1 - c_1^m)[\Delta \overline{rm}_t + \left(\pi_t^{4,tar} - \left(1 - w_{p_c}\right)\Delta rp_t^{tnd}\right) \ldots$$
$$\ldots + c_2^m(rs_t - rs_t^{neutral}) - c_3^m \pi_t^{4,dev} - c_4^m \hat{y}_t - c_5^m \left(\Delta m_t - \Delta^4 m_t^{tar}\right)] + c_6^m(res_t^{rat} - res_{t-1}^{rat}) + \varepsilon_t^{\Delta m}$$

Deviation of core inflation from target:

$$\pi_t^{4,dev} = E_t \pi_{t+3}^{4,c} - E_t \pi_{t+3}^{4,tar}$$

Core inflation target:

$$\pi_t^{4,tar} = \rho_{\pi_t^{4,tar}} \pi_{t-1}^{4,tar} + \left(1 - \rho_{\pi_t^{4,tar}}\right) \pi_{ss}^{4,tar} + \varepsilon_t^{\pi_t^{4,tar}}$$

Quarterly nominal money growth target:

$$\Delta m_t^{tar} = c_1^{mtar} \Delta m_{t-1}^{tar} + \left(1 - c_1^{mtar}\right)\Delta \overline{ny_{ss}^{ne}} - c_2^{mtar}(rm_{t-1}^{tar} - \overline{rm}_{t-1}) + \varepsilon_t^{mtar}$$

Real money supply target:

$$rm_t^{tar} = m_t^{tar} - p_t$$

Real money demand, trend and gap decomposition:

$$rm_t = m_t - p_t$$
$$rm_t = \overline{rm}_t + \widehat{rm}_t$$

Real money demand gap

$$\widehat{rm}_t = c_1^{rm} \widehat{rm}_{t-1} - c_2^{rm} \hat{r}_t + c_3^{rm} \hat{y}_t + c_4^{rm} \left(debt_t^{rat} - debt^{rat,tar}\right) + c_5^{rm}(res_t^{rat} - res_{t-1}^{rat}) + \varepsilon_t^{rm}$$

Real money trend growth:

$$\Delta \overline{rm}_t = w_{y_e} \Delta \overline{y_t^e} + \left(1 - w_{y_e}\right)\Delta \overline{y_t^{ne}} - \Delta v_t - c_1^{\Delta \overline{rm}}(\bar{r}_t - \bar{r}_{t-1}) + \varepsilon_t^{\Delta \overline{rm}}$$

Velocity of money growth:

$$\Delta v_t = \rho_v \Delta v_{t-1} + \left(1 - \rho_v\right) \Delta v_{ss} + \varepsilon_t^v$$

Neutral nominal interest rate:

$$rs_t^{neutral} = r_t + E_t \pi_{t+1}^{4,c} + \left(1 - w_{p_c}\right)E_t \Delta rp_{t+1}^{tnd}$$

Fisher equation:

$$r_t = rs_t - E_t(\pi_{t+1}^{4,c} - \left(1 - w_{p_c}\right)\Delta rp_{t+1}^{tnd})$$

Trend and gap decomposition of real interest rate:

$$r_t = \bar{r}_t + \hat{r}_t$$
$$\bar{r}_t = \rho_r \bar{r}_{t-1} + \left(1 - \rho_r\right) \bar{r}_{ss} + \varepsilon_t^r$$

Monetary conditions index:

$$mci_t = c_1^{mci} \hat{r}_t + (1 - c_1^{mci})(-\hat{z}_t)$$

Exchange Rate Policy

Nominal exchange rate (uncovered interest rate parity condition):

$$s_t = c_1^s \left\{ s_{t-1} + \frac{\Delta s_t^{pol}}{4} \right\} + (1 - c_1^s) \left\{ s_{t+1}{}^F - (rs_t - rs_t^{rw} - prem_t)/4) \right\} + \cdots$$

$$\cdots (1 - c_1^s) \left\{ -c_3^s \, \hat{tb}_t^{rat} + c_4^s \left(debt_t^{rat} - debt^{rat,tar} \right) \right\} + \varepsilon_t^s$$

Nominal exchange rate expectations:

$$s_{t+1}{}^F = c_2^s \, E_t s_{t+1} + (1 - c_2^s) \left\{ s_{t-1} + \frac{2}{4} \Delta s_t^{tar} \right\}$$

Exchange rate target depreciation rate:

$$\Delta s_t^{tar} = \Delta \bar{z}_t - \pi_t^{4,rw} + \pi_t^{4,tar}$$

Exchange rate policy depreciation rate:

$$\Delta s_t^{pol} = c_1^{Spol} \Delta s_{t-1}^{pol} + \left(1 - c_1^{Spol} \right) \left\{ \Delta s_t^{tar} - c_2^{Spol} \hat{z}_t - c_3^{Spol} \pi_t^{4,dev} \right\} + \varepsilon_t^{Spol}$$

Real uncovered interest rate parity condition:

$$\Delta \bar{z}_t = \bar{r}_t - \overline{r_t^{rw}} - prem_t - \left(1 - w_{pc} \right) \Delta rp_t^{tnd}$$

Real exchange rate, trend and gap decomposition:

$$z_t = s_t + p_t^{rw} - p_t^c$$

$$z_t = \bar{z}_t + \hat{z}_t$$

$$\Delta \bar{z}_t = \rho_{\Delta z} \Delta \bar{z}_{t-1} + (1 - \rho_{\Delta z}) \Delta \bar{z}_{ss} + \varepsilon_t^{\Delta \bar{z}}$$

Fiscal Policy

Headline budget deficit:

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

Primary deficit:

$$pdef_t^{rat} = pdef_t^{\,rat,struct} + pdef_t^{\,rat,cyc} + \varepsilon_t^{pdef^{rat}}$$

Cyclical component of the primary deficit:

$$pdef_t^{\,rat,cyc} = -c_1^{pdef^{rat,cyc}} \hat{y}_t^{ne} - c_2^{pdef^{rat,cyc}} \widehat{zen}_t + \varepsilon_t^{pdef^{rat,cyc}}$$

Fiscal policy reaction function for cyclically adjusted primary deficit:

$$pdef_t^{rat,struct} = \left(pdef_{t-1}^{rat,struct} - c_1^{pdef^{rat,struc}} \hat{y}_t^{ne} \right) + \left(1 - \rho_{def} \right) \left(pdef_t^{rat,tar} - c_2^{pdef^{rat,struct}} \widehat{debt}_t^{rat} \right) + \varepsilon_t^{defstruct^{rat}}$$

Fiscal impulse:

$$fimp_t^{rat} = c_1^{fimp^{rat}} \left(4 \cdot \left(pdef_t^{rat,struct} - pdef_{t-1}^{rat,struct} \right) \right) + (1 - c_1^{fimp^{rat}}) \left(4 \cdot \left(pdef_t^{rat,struct} - pdef_{ss}^{rat,struct} \right) \right)$$

Four-quarter moving average of the fiscal impulse in the IS curve:

$$fisc_t = \frac{1}{4} \cdot \left(fimp_t^{rat} + fimp_{t-1}^{rat} + fimp_{t-2}^{rat} + fimp_{t-3}^{rat} \right)$$

Total outstanding debt as a share of nominal GDP:

$$debt_t^{rat} = debt_t^{m,rat} + debt_t^{nm,rat}$$

Total stock of 1-year marketable and non-marketable debt:

$$debt_t^{m,rat} = debt1y_t^{m,rat} + \frac{debt1y_{t-1}^{m,rat}}{\exp\left(\frac{\Delta ny_t}{400}\right)} + \frac{debt1y_{t-2}^{m,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1}}{400}\right)} + \frac{debt1y_{t-3}^{m,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1} + \Delta ny_{t-2}}{400}\right)}$$

$$debt_t^{nm,rat} = debt1y_t^{nm,rat} + \frac{debt1y_{t-1}^{nm,rat}}{\exp\left(\frac{\Delta ny_t}{400}\right)} + \frac{debt1y_{t-2}^{nm,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1}}{400}\right)} + \frac{debt1y_{t-3}^{m,rat}}{\exp\left(\frac{\Delta ny_t + \Delta ny_{t-1} + \Delta ny_{t-2}}{400}\right)}$$

Newly issued 1-year marketable and non-marketable debt (for $j \in \{m, nm\}$):

$$debt1y_t^{m,rat} = \theta_t \cdot def_t^{rat} + \frac{debt1y_{t-4}^{m,rat}}{\exp\left(\frac{\Delta ny_t^4}{100}\right)} - restruct_t + \varepsilon_t^{debt1y_t^{m,rat}}$$

$$debt1y_t^{nm,rat} = (1 - \theta_t) \cdot def_t^{rat} + \frac{debt1y_{t-4}^{nm,rat}}{\exp\left(\frac{\Delta ny_t^4}{100}\right)} + restruct_t + \varepsilon_t^{debt1y_t^{nm,rat}}$$

Fiscal anchor for the total debt target:

$$debt_t^{rat,tar} = \rho debt_{t-1}^{rat,tar} + (1 - \rho)debt^{rat,ss} + \varepsilon_t^{debt^{rat,tar}}$$

Share of marketable financing:

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

Restructuring of outstanding debt stock:

$$restruct_t = \rho_{restruct} restruct_{t-1} + \varepsilon_t^{restruct}$$

Total debt service:

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

Domestic debt service:

$$intcost_t^{d,rat} = intcost_t^{m,rat} + intcost_t^{nm,rat}$$

Debt service for marketable and non-marketable debt (for $j \in \{m, nm\}$):

$$intcost_t^{j,rat} = \frac{\left(\exp\left(\frac{i4_{t-1}^j}{400}\right) - 1\right)debt1y_{t-1}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-2}^j}{400}\right) - 1\right)debt1y_{t-2}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400}\right)} + \cdots$$

$$\frac{\left(\exp\left(\frac{i4_{t-3}^j}{400}\right) - 1\right)debt1y_{t-3}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400} + \frac{\Delta ny_{t-2}}{400}\right)} + \frac{\left(\exp\left(\frac{i4_{t-4}^j}{400}\right) - 1\right)debt1y_{t-4}^{j,rat}}{\exp\left(\frac{\Delta ny_t}{400} + \frac{\Delta ny_{t-1}}{400} + \frac{\Delta ny_{t-2}}{400} + \frac{\Delta ny_{t-3}}{400}\right)}$$

1-year interest rate for marketable and non-marketable debt

$$i4_t^m = E_t\left(\frac{rs_t + rs_{t+1} + rs_{t+2} + rs_{t+3}}{4} + tprem_t^m\right)$$

$$i4_t^{nm} = \left(i4^{nm,ss} + tprem_t^{nm}\right)$$

1-year term premium for marketable and non-marketable debt (for $j \in \{m, nm\}$):

$$tprem_t^j = \rho_{tprem} tprem_{t-1}^j + (1 - \rho_{tprem})\left[tprem^{j,ss} + c_1^{tprem}(debt_t^{rat} - debt^{rat,tar})\right] + \varepsilon_t^{tprem^j}$$

B.4 Foreign Economy

US output gap:

$$\hat{y}_t^{rw} = \rho_{y_{rw}}\hat{y}_{t-1}^{rw} + \varepsilon_t^{y_{rw}}$$

US CPI:

$$\pi_t^{rw} = \rho_{\pi_{rw}}\pi_{t-1}^{rw} + (1 - \rho_{\pi_{rw}})\overline{\pi_{ss}^{rw}} + \varepsilon_t^{\pi_{rw}}$$

US interest rate and real trend:

$$rs_t^{rw} = \rho_{rs_{rw}}rs_{t-1}^{rw} + (1 - \rho_{rs_{rw}})(\overline{r_{ss}^{rw}} + \overline{\pi_{ss}^{rw}}) + \varepsilon_t^{rs_{rw}}$$

$$\overline{r_{ss}^{rw}} = \rho_{r_{rw}}r_{t-1}^{rw} + (1 - \rho_{r_{rw}})(\overline{r_{ss}^{rw}}) + \varepsilon_t^{r_{rw}}$$

Relative price of composite energy index:

$$zen_t = en_t - p_t^{rw}$$

Trend and gap decomposition of real composite energy index:

$$zen_t = \overline{zen_t} + \widehat{zen_t}$$

$$\widehat{zen}_t = \rho_{\widehat{zen}}\widehat{zen}_{t-1} + \varepsilon_t^{\widehat{zen}}$$

$$\Delta\overline{zen}_t = \rho_{\overline{zen}}\Delta\overline{zen}_{t-1} + (1 - \rho_{\overline{zen}})\Delta\overline{zen}_{ss} + \varepsilon_t^{zen}$$

Appendix C. Parameters

Real Aggregate Demand			
Code	Value	Parameter role	Calibration choice and justification
b_1^{yne}	0.4	Non-extractive GDP gap lag term	Iterative adjustment
b_2^{yne}	0.2	Monetary conditions elasticity	Iterative adjustment
b_3^{yne}	0.1	Trade balance gap elasticity	Iterative adjustment
b_4^{yne}	0.3	Fiscal impulse elasticity	Iterative adjustment
c_1^{ye}	0.6	Extractive GDP gap lag term	Iterative adjustment
c_2^{ye}	0.05	Energy price elasticity	Iterative adjustment
w_{ye}	0.1	Weight of extractive GDP	Historical data
$\rho_{\Delta y_e}$	0.8	Persistence of extractive GDP trend growth	Iterative adjustment
$\rho_{\Delta y_{ne}}$	0.85	Persistence of non-extractive GDP trend growth	Iterative adjustment
$\rho_{\Delta ny_{ne}}$	0	Persistence of non-extractive nominal GDP trend growth	Iterative adjustment
Steady States			
$\Delta\bar{y}_{ss}^e$	0.5	Extractive GDP trend growth	Historical data
$\Delta\bar{y}_{ss}^{ne}$	4.5	Non-extractive GDP trend growth	Historical data
$\Delta\overline{ny}_{ss}^{ne}$	8	Non-extractive nominal GDP trend growth	Historical data

Aggregate Supply			
Code	Value	Parameter role	Calibration choice and justification
w_{p_c}	0.83082	Weight of core items	ONS data
$c_1^{\pi_c}$	0.5	Core inflation lead term	Iterative adjustment
$c_2^{\pi_c}$	0.2	RMC elasticity of core inflation	Iterative adjustment
$c_1^{rmc_c}$	0.4	Weight of extractive GDP gap in core RMC	Iterative adjustment
$c_2^{rmc_c}$	0.035	Weight of energy prices in core RMC	Iterative adjustment
$c_1^{\pi_{nc}}$	0.5	Non-core inflation lead term	Iterative adjustment
$c_2^{\pi_{nc}}$	0.1	RMC elasticity of non-core inflation	Iterative adjustment
$c_1^{rmc_{nc}}$	0.5	Weight of extractive GDP gap in non-core RMC	Iterative adjustment
$c_2^{rmc_{nc}}$	0.025	Weight of energy prices in non-core RMC	Iterative adjustment
ρ_{rp}	0.7	Relative core price trend growth lag	Iterative adjustment
Steady State			
Δrp_{ss}	-2.5	Relative core price growth	Historical data

Balance of Payments			
Code	Value	Parameter role	Calibration choice and justification
$c_1^{\widetilde{tb}^{rat}}$	0.6	Trade balance gap lag term	Iterative adjustment
$c_2^{\widetilde{tb}^{rat}}$	0.4	Energy price elasticity	Iterative adjustment
$c_3^{\widetilde{tb}^{rat}}$	1	Foreign output gap elasticity	Iterative adjustment
$c_4^{\widetilde{tb}^{rat}}$	3	Non-extractive GDP gap elasticity	Iterative adjustment
$c_5^{\widetilde{tb}^{rat}}$	0.3	Extractive GDP gap elasticity	Iterative adjustment

Code	Value	Parameter role	Calibration choice
$c_6^{\overline{tb}^{rat}}$	0.6	Real exchange rate gap elasticity	Iterative adjustment
$c_7^{\overline{tb}^{rat}}$	1	Deviation of structural primary deficit elasticity	Iterative adjustment
$c_1^{\overline{tb}^{rat}}$	0.95	Trade balance trend lag term	Iterative adjustment
$c_2^{\overline{tb}^{rat}}$	1	Energy prices trend elasticity	Iterative adjustment
$c_1^{ca^{other,rat}}$	0.25	Other current account items lag term	Iterative adjustment
$c_1^{kfa^{nonres,rat}}$	0.75	Endogenous non-reserve financial flows lag term	Iterative adjustment
$c_2^{kfa^{nonres,rat}}$	0.1	Risk premium elasticity	Iterative adjustment
Steady States			
$\overline{tb}_{ss}^{rat}$	-2	Trade balance	Historical data
$ca_{ss}^{other,rat}$	-0.6	Other current account items	Historical data
$kfanonres_{ss}^{rat}$	0.4	Endogenous non-reserve financial inflows	Historical data

Monetary Policy			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
c_1^m	0.6	Money growth lag term	Iterative adjustment
c_2^m	0.5	Deviation of interbank rate from neutral rate	Iterative adjustment
c_3^m	1.2	Deviation of core inflation from target	Iterative adjustment
c_4^m	0.6	Output gap	Iterative adjustment
c_5^m	0.6	Deviation of money growth from target	Iterative adjustment
c_6^m	0.4	Change in (non-sterilized) FX reserves	Iterative adjustment
$c_1^{m tar}$	0.7	Nominal money growth target lag term	Iterative adjustment
$c_2^{m tar}$	0.2	Deviation of real money target from trend	Iterative adjustment
c_1^{rm}	0.7	Real money demand gap lag term	Iterative adjustment
c_2^{rm}	2.5	Real interest rate gap elasticity	Iterative adjustment
c_3^{rm}	1.1	Output gap elasticity	Iterative adjustment
c_4^{rm}	0.2	Debt deviation from target elasticity	Iterative adjustment
c_5^{rm}	0.1	Change in reserves elasticity	Iterative adjustment
$c_1^{\Delta \overline{rm}}$	1.2	Change in the real interest rate trend elasticity	Iterative adjustment
c_1^{mci}	0.6	Weight of real interest rate gap in RMCI	Iterative adjustment
ρ_r	0.7	Persistence real interest rate trend	Iterative adjustment
$\rho_{\pi_t^{4,tar}}$	0.99	Persistence core inflation target	Iterative adjustment
ρ_v	0.9	Persistence money velocity growth	Iterative adjustment
Steady States			
$\pi_{ss}^{4,tar}$	4	Core inflation target	BA strategy
$\bar{r}_{ss}$	-1.5	Real interest rate trend	Historical data

Exchange Rate			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
c_1^s	0.75	UIP weight of BA reference rate	Iterative adjustment
c_2^s	0.1	Forward-looking expectations	Iterative adjustment
c_3^s	0.1	Trade balance gap elasticity	Iterative adjustment
c_4^s	0.06	Debt deviation from target elasticity	Iterative adjustment
$c_1^{S pol}$	0.75	Policy exchange rate depreciation lag term	Iterative adjustment
$c_2^{S pol}$	0.6	Real exchange rate gap elasticity	Iterative adjustment
$c_3^{S pol}$	0.2	Inflation deviation from target elasticity	Iterative adjustment
$\rho_{\Delta z}$	0.9	Persistence real exchange rate trend growth	Iterative adjustment
Steady State			
$\Delta \bar{z}_{ss}$	0	Real exchange rate trend growth	Historical data

Fiscal policy			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
$c_1^{pdef\,rat,cyc}$	0.1	Non-extractive output gap cyclical elasticity	Iterative adjustment
$c_2^{pdef\,rat,cyc}$	0.035	Energy price cyclical elasticity	Iterative adjustment
ρ_{def}	0.5	Smoothing of fiscal reaction function	Iterative adjustment
$c_1^{pdef\,rat,struc}$	0.2	Non-extractive output gap elasticity of fiscal policy	Iterative adjustment
$c_2^{pdef\,rat,struct}$	0.4	Debt deviation elasticity of fiscal policy	Iterative adjustment
$c_1^{fimp\,rat}$	0.75	Fiscal impulse weight on the deficit change	Iterative adjustment
c_1^{tprem}	0.01	Debt deviation elasticity of term premia	Iterative adjustment
ρ_{debt}	0.99	Public debt target lag term	Iterative adjustment
ρ_{θ}	0.9	Share of marketable financing lag term	Iterative adjustment
$\rho_{restruct}$	0.7	Restructuring of outstanding debt lag term	Iterative adjustment
ρ_{tprem}	0.75	1-year term premium lag term	Iterative adjustment
Steady States			
$debt^{rat,ss}$	48	Public debt target	Expert judgement
θ^{ss}	1	Share of marketable financing	Expert judgement
$prem^{m,ss}$	1.75	1-year term premium for marketable debt	Historical data
$prem^{nm,ss}$	0	1-year term premium for non-marketable debt	Historical data
$i4^{nm,ss}$	1	1-year non-marketable debt interest rate	Expert judgement

Foreign Economy			
Code	**Value**	**Parameter role**	**Calibration choice and justification**
Commodity prices			
$\rho_{\overline{zen}}$	0.95	Relative price of energy trend lag term	Iterative adjustment
$\rho_{\widehat{zen}}$	0.75	Relative price of energy gap lag term	Iterative adjustment
$\rho_{\pi_{rw}}$	0.25	US inflation lag term	Iterative adjustment
$\rho_{rs_{rw}}$	0.9	US interest rate lag term	Iterative adjustment
$\rho_{y_{rw}}$	0.85	US output gap lag term	Iterative adjustment
$\rho_{r_{rw}}$	0.95	US real interest rate lag term	Iterative adjustment
Steady State			
$\overline{r_{ss}^{rw}}$	0	US real interest rate	Historical data
$\overline{\pi_{ss}^{rw}}$	2	US inflation	Fed strategy
$\overline{\Delta \overline{zen}_{ss}}$	0	Relative price of energy growth	Historical data

PUBLICATIONS