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ALGERIA

SELECTED ISSUES

January 12, 2023

Approved By
Middle East and Central Asia Department

Prepared by Fabien Gonguet (FAD), Mahmoud Harb (MCD) and Priscilla Muthoora (MCD) as background documentation for the periodic consultation with Algeria. It is based on the information available at the time it was completed on November 21, 2022.

CONTENTS

TABLES

APPENDIX

FIGURES

TABLES

APPENDIX

DESIGNING A RULES-BASED FISCAL FRAMEWORK FOR ALGERIA[1]

A. Introduction

1. Algeria's government has set a number of fiscal reform priorities and aims to maintain prudent and sustainable policies. The 2021 Government Action Plan ("*Plan d'Action du Gouvernement*", PAG) sets an ambitious policy agenda for fiscal reforms aiming at "*responding to the imperatives of preserving financial balances while maintaining the social role of public policies*". It also identifies strategic goals for fiscal policy, including promoting economic diversification, enhancing job creation, and reinforcing human capital.

2. Yet, the fiscal policy stance and limited fiscal buffers are raising Algeria's vulnerabilities and pose risks to macroeconomic stability. At the current juncture, public finances are benefiting from a strong boost from high hydrocarbon prices. Still, fiscal buffers are thin, leaving public finances highly vulnerable to hydrocarbon market vagaries amid a highly uncertain global backdrop. Existing mechanisms meant to smooth oil revenue and accumulate savings have become much less effective in recent years. Meanwhile government debt has risen rapidly and considerably and, after a temporary decline in 2022-23, is projected to resume its ascension in the medium term, constraining fiscal space. In case of renewed hydrocarbon price shocks, the government is likely to face arduous tradeoffs between its set policy priorities in order to preserve fiscal sustainability.

3. This paper discusses the design of a rules-based fiscal framework which could help rebuild buffers and support the government's policy agenda. The proposed calibration, which relies on two separate pillars— a gross debt pillar and a savings pillar—is well-suited to Algeria and to its long-term objectives. The paper finds that building a fiscal buffer of about 40 percent of GDP, via the combination of a savings floor and a safe gross debt target (or debt anchor), could preserve medium-term fiscal sustainability and insure public finances against hydrocarbon price shocks. The savings floor is calibrated based on a stochastic approach so as to protect Algerian public finances against hydrocarbon price shocks. The debt anchor, or medium-term gross debt target, is calibrated so as to prevent debt from reaching potentially unsustainable territory under a wide range of macro-fiscal scenarios.

4. A multiyear transition period is needed to set the proposed rules-based framework in place. Given that the build-up of savings in 2022 is projected to be temporary and the savings fund is projected to be depleted as early as 2023, a transition period of 8 years would be needed to reach the recommended targets. This transition period would allow the authorities to implement a medium-term fiscal adjustment strategy and gradually replenish their savings.

[1] Prepared by Fabien Gonguet (FAD) and Mahmoud Harb (MCD). The authors are indebted to Luc Eyraud (AFR) and William Gbohoui (MCD) for their valuable insights. Jarin Nashin provided excellent research assistance.

5. While based on existing IMF guidance, the dual-pillar approach is novel. On top of ensuring fiscal sustainability through debt anchors, the traditional focus of fiscal rules in resource-rich countries has been on promoting intergenerational equity through frameworks built around the permanent income hypotheses (PIH). Yet, in light of the very high volatility of resource prices in recent years, growing attention is now being given to designing fiscal rules with a precautionary purpose (Eyraud and others 2018a)—e.g. revenue-split mechanisms, price smoothing frameworks. This is the focus we adopt in this paper, by proposing to restore the effectiveness of the oil stabilization fund in the medium term and calibrating a savings floor that can help smooth hydrocarbon volatility. This paper does not explicitly consider the intergenerational equity objective in the design of the proposed rules-based fiscal framework.[2] This objective remains nonetheless important in the authorities' reform agenda; the PAG aims at the transition of the Algerian economy to sustainable and inclusive growth, relying less on hydrocarbon production, and ensuring the welfare of future generations.

6. Given that Algeria's precautionary savings are thin and the need to reduce gross debt, we propose reliance on two distinct objectives rather than on a single "net" anchor. To do so, we combine two calibration methodologies—a value-at-risk model similar to the approach proposed in IMF (2012) and the IMF's Fiscal Affairs Department gross debt calibration tool (Eyraud and others 2018c)—in an original fashion. Once the authorities have replenished savings and stabilized debt, i.e. after the 8 -year transition period, they will be able to target a single "net" anchor, as the difference between gross debt and precautionary savings. This could require a complementary model to resolve the tradeoff between debt accumulation/paydown and asset drawdown/buildup, for example through an integrated asset-liability framework (Maziad and Skancke 2014), an area we leave for future research. After the transition period, authorities could also adopt a system of operational rules that would help actively maintain compliance, combining an oil-price smoothing rule and a ceiling on either the non-resource balance or expenditure.

7. The paper also explores design considerations in terms of flexibility and enforceability. These include escape clauses and correction mechanisms—that can help ensure the effectiveness of the framework. It finally touches upon concomitant public financial management (PFM) reforms which are required to maximize the effectiveness of the framework in Algeria, emphasizing reporting and transparency, and budget monitoring capacity within the Ministry of Finance.

8. The rest of the paper proceeds as follows. Section B discusses the rationale for a fiscal rule framework in Algeria, based on a brief background analysis of past and expected fiscal policy challenges. Section C introduces a proposed calibration for a rules-based fiscal framework. Section D examines important design considerations and PFM reforms to support the successful and effective implementation of this framework. Section E concludes.

[2] The high sensitivity of PIH-like frameworks to assumptions on asset returns, oil prices and the size of hydrocarbon resources also makes their immediate application challenging in the current context of high global uncertainty and oil price volatility.

B. The Case for a Rules-Based Fiscal Framework in Algeria

9. Fluctuations in oil prices have fueled budget revenue volatility in Algeria and the fiscal policy stance tends to be procyclical (Figure 1). Hydrocarbon revenue provides Algeria with substantial financial resources, accounting for around half of total budget revenue in the last decade. However, its volatility is a major challenge for fiscal and economic management. The standard deviation of budget hydrocarbon revenue has exceeded 6 percent of GDP since 2011 mostly due to fluctuations in hydrocarbon prices. The fiscal response to oil revenue volatility has often been procyclical, i.e. fiscal policy is expansionary during booms and contractionary in a downturn and does not act as a macroeconomic stabilizer; such procyclicality has been shown to harm long-term growth (IMF 2015). Algeria's fiscal policy stance—measured by the change in the non-hydrocarbon primary balance relative to non-hydrocarbon GDP—has often been loosened during oil price upswings and tightened during downturns. This procyclical pattern was observed in fourteen of the last twenty years although 2022 seems to have been an exception, meaning that fiscal policy might have fail to dampen the impact of oil price shocks on the rest of the economy. [3] An econometric analysis building on the approach presented in IMF (2015) confirms this conclusion: we find a positive association between real government spending and the change in the terms-of-trade (ToT) for Algeria, pointing to fiscal procyclicality. On average, a 10 percent change in the growth of Algeria's ToT—which are mostly dominated by hydrocarbons—is associated with a 4.6 percent change in the growth of real government spending.[4]

10. Thin fiscal savings and weakened revenue-split mechanism based on the Revenue Regulation Fund (*« Fonds de Régulation des Recettes »*, FRR) exacerbate the exposure of Algeria's public finances to oil market vagaries. The FRR constitutes, in principle, an oil-price smoothing mechanism. The supplementary budget law for 2000 which created it (Article 10) simply required that, when oil prices exceed a benchmark level defined in the budget law for a given year, all windfall gains realized that year should be transferred to the FRR. In practice, the nature of the FRR mechanism started to change in 2006, when a budget law authorized withdrawals from the fund to finance the deficit, albeit irrespective of oil prices, while setting a minimum balance requirement (DZD 740 billion). Nonetheless, the FRR grew to become one of the largest sovereign wealth funds on the African continent, with financial assets over 30 percent of GDP over the period 2011-13. However, as fiscal funding needs ballooned following the 2014-2015 oil price shock, the 2017 budget law abolished the FRR's minimum balance requirement, leading to the full depletion of the fund that year. The balance of the FRR is estimated by staff at close to DZD 2,000 billion at end-2022 reflecting savings accumulation since late 2021, but an announced sizeable rise in budget spending under the 2023 budget law is likely to deplete the fund in 2023.

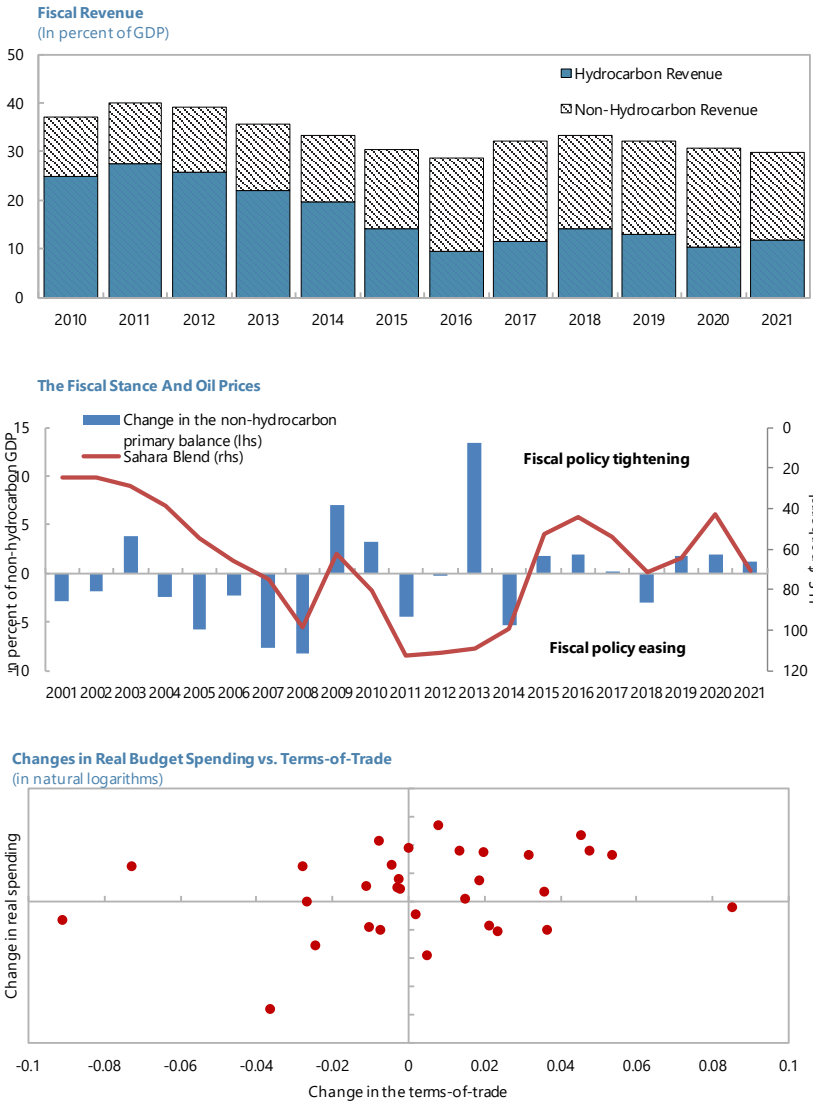
11. A rapid debt built-up has also weakened the resilience of public finances to exogenous shocks. Algeria's government debt has risen from a low point of 7.1 percent of GDP at end-2013 to

[3] See the Staff report on the 2022 Article IV consultation with Algeria for further discussion of fiscal policy in 2022.

[4] We consider the growth in real spending as a proxy for discretionary fiscal measures given its weak elasticity to the state of the economic cycle (Fatas and Mihov 2003).

6.8 percent of GDP at end-2021. It is projected to temporarily fall to 49.4 percent of GDP at end-2023 on high nominal growth and temporary fiscal surplus in 2022, before resuming an upward trajectory in the medium term. This rise in debt between 2013 and 2021 reflected the impact of repeated exogenous shocks, including the 2014-2015 and 2020 slumps in oil prices and the Covid-19 pandemic, and continued wide budget deficits. Going forward, the debt build-up leaves little room to absorb new shocks without posing risks to macroeconomic stability or to the government's policy priorities, raising the pressing need for well-articulated fiscal adjustment plans and a reassessment of the policy framework to achieve fiscal sustainability while preserving priority spending.

Figure 1. Oil Prices and Public Finance

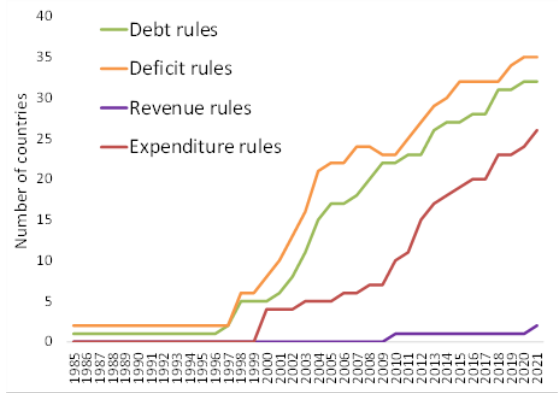


Sources: National authorities, IMF staff's estimates and forecasts

12. A well-designed rules-based fiscal framework would help address the challenge of stabilizing debt and rebuilding resilience to oil price volatility. As per the IMF definition, numerical fiscal rules (or "fiscal rules") impose long-lasting constraints on fiscal policy through numerical limits on broad fiscal aggregates. There is empirical evidence of the effectiveness of fiscal rules in improving fiscal outcomes, including during and after economic crises.[5] This is because well-designed fiscal rules, which strike an appropriate balance between simplicity, flexibility and enforceability, promote fiscal discipline and prevent deficit bias, while still allowing for countercyclical policies when needed. They also act as commitment devices, enhancing the credibility of fiscal policies, increase the transparency and produce a signaling effect. Lastly, they play a political role, helping to rally support around fiscal goals. In the case of Algeria, a rules-based framework would help cushion public finances against gyrations in oil prices and dampen the procyclical bias, while facilitating the reconstitution of fiscal reserves. It would also help protect debt sustainability in the medium term.

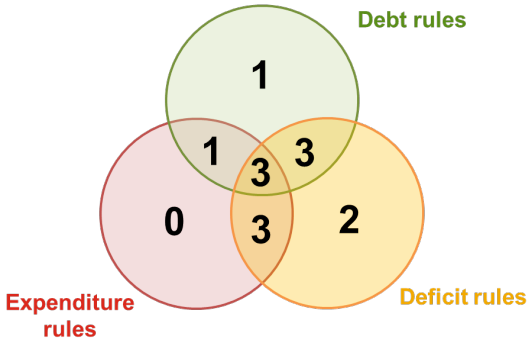
13. A growing number of emerging countries and resource exporters have implemented a fiscal rule framework. According to the IMF's Fiscal Affairs Department Fiscal Rules dataset (2022), forty-three emerging economies had at least one fiscal rule in 2021 (twice as much as two decades ago), including thirteen resource-rich economies (Figure 2). Of these thirteen economies, most have combined a deficit rule with a debt rule and/or an expenditure rule (Figure 3). [6]

Figure 2. Number of Emerging Economies Having Adopted at Least a Fiscal Rule



Source: IMF Fiscal Rules Dataset (2022)

Figure 3. Number of Resource-Rich Emerging Economies Having Adopted Various Combinations of Fiscal Rules



TOTAL: 13 countries

[5] See Fiscal Monitor (October 2021). Governments which have adopted a debt rule are usually more cautious and manage to overturn an increase in debt faster than countries without one (David and others 2022, forthcoming). There is also evidence that the credibility of official forecasts is higher when countries adhere to a fiscal rule framework (End and Hong, 2022 forthcoming).

[6] Azerbaijan, Botswana, Chile, Colombia, Ecuador, Equatorial Guinea, Indonesia, Iran, Kazakhstan, Namibia, Peru, Russia, Turkmenistan.

C. Designing and Calibrating a Rules-Based Fiscal Framework in Algeria

14. A new rules-based fiscal framework in Algeria could build on recent structural fiscal reforms. Preserving fiscal sustainability is an explicit policy priority which has been enshrined in the 2018 Organic Budget Law (OBL)—Article 5 states that budget preparation, adoption and execution should be consistent with a sustainable path set in a medium-term budget framework. The OBL also provides the government with the legal means to set a rule or targets on its deficit. Article 3 states that "*in its financial management, the government looks to prioritize the coverage of its current expenditure with ordinary* [non-oil] *revenue. The coverage ratio is set in a budget law*". This provision constitutes an expression of fiscal discipline, as it aims to avoid using volatile oil revenue to finance relatively inert spending items. The dispositions of Article 3 remain however insufficient to address Algeria's fiscal challenges described in the previous section—they do not prevent procyclical fiscal policy, nor impose limitations on the coverage ratio, which could be set at low levels in practice.

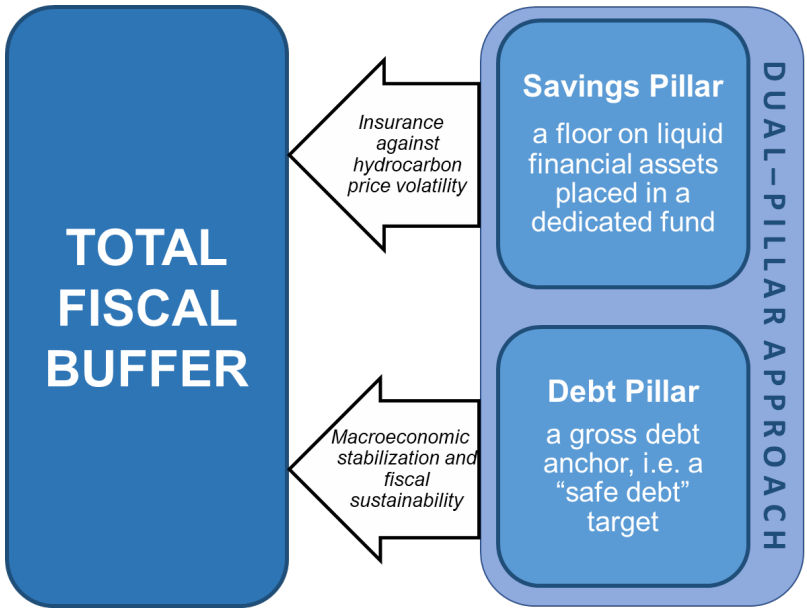
15. We propose the adoption of a rules-based framework combining a carefully calibrated gross debt anchor and a savings floor, which would support the authorities' policy priorities and help preserve fiscal sustainability. This dual-pillar framework (Figure 4) would be adapted to the case of a resource-rich country like Algeria:

- The **debt anchor** requires keeping total government debt below a certain level, i.e. targeting a "safe debt" level taking into consideration Algeria's debt carrying capacity, policy priorities, exposure to macroeconomic and fiscal shocks and other idiosyncratic characteristics. This should help preserve fiscal sustainability, leaving room for the materialization of negative shocks and giving space for countercyclical fiscal policies.

- The **savings floor** requires keeping liquid financial assets above a certain floor, i.e. accumulating, in a dedicated fund, a stock of liquid resource-related wealth invested overseas. This would first and foremost serve a precautionary motive and offer a self-insurance mechanism against sharp downswings in commodity prices by smoothing resource revenue and avoiding undesired and large adjustment in budget spending.[7] The savings pillar would also support macroeconomic stability and dampen the typical procyclicality of Algeria's fiscal policy: saving a share of resource revenue constrains spending during booms, while asset drawdown expands fiscal space in times of bust, helps to stabilize spending in an economic downturn and shields public finances against tightening market conditions which typically comove with oil prices for hydrocarbon exporters. Restraining public spending, and hence domestic absorption, when commodity prices are high would also contribute to mitigating the effects of Dutch disease (Eyraud and others, forthcoming), promoting economic diversification and long-term growth.

[7] Financial instruments such as futures and forwards can be also used to hedge budget revenue against the volatility of oil prices. However, such instruments can be complex and costly.

Figure 4. A Dual-Pillar Approach For a Rules-Based Fiscal Framework in Algeria



Source: IMF staff.

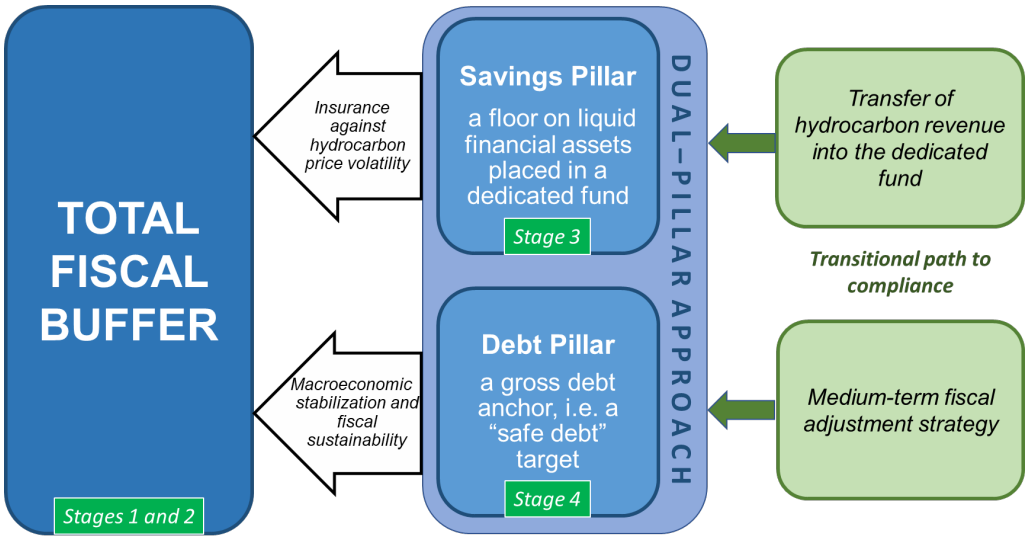
16. Given Algeria's sizeable gross debt level and thin fiscal savings, we propose a combination of a gross debt anchor and a savings floor, rather than an anchor on net debt. In general, a net debt target is ideally a more relevant stock variable to use as an anchor, provided the government can liquidate financial assets easily to cover its obligations (Eyraud and others 2018b). However, asset drawdowns or debt accumulation can be imperfect substitutes, particularly in times of shock and for a country with a significant debt burden like Algeria, making it important to maintain two separate objectives as long as debt is high and savings depleted, rather than a "net" target on debt minus savings. Indeed, a "net" target could in theory be achieved with a debt buffer only and no savings. While a debt buffer is relevant to ensure sustainability in the medium term, this might not necessarily protect priority spending against oil price shocks in the near term due to financing constraints, since market financing conditions for oil producers tend to co-move with hydrocarbon prices.[8] Accumulating foreign assets in a savings fund would help cushion near-term oil price volatility, over 1-3 years for example, while protecting priority spending. Fiscal adjustment to persistent shocks would remain necessary under the proposed framework but can be staged over time. In the medium term, once the stock of savings has increased to sufficient levels and gross debt has been brought down, after the 10-year transition period, the Algerian authorities could consider a single, integrated "net" anchor, based on the difference between gross debt and the savings fund's assets. This would give the authorities more flexibility (e.g. this would allow for higher gross debt, as long as savings are also higher). An integrated asset-liability framework could then be used to manage the sovereign's balance sheet.

[8] Algeria also has limited track record of accessing foreign private or official financing in recent decades and the authorities are reluctant to borrow externally, while the absorption capacity of its domestic markets is constrained.

17. Establishing a debt anchor and building a savings floor both entail opportunity costs which can be large in a lower middle-income country like Algeria, calling for their adequate calibration. Finding the appropriate level of buffers is difficult yet critical—insufficient buffers put fiscal sustainability at risk, while superfluous buffers are missed opportunities for productive spending. Locking too much hydrocarbon revenue in a savings fund or excessively capping the deficit could indeed constrain spending in areas where needs are high, such as education, social protection and infrastructure. Policymakers might also face political and social pressures to spend hydrocarbon windfall revenue or large accumulated savings on consumption and wages. Given these opportunity costs which are akin to an "insurance premium", the debt and savings buffers should be calibrated to offer adequate insurance coverage and ensure fiscal sustainability, without impeding opportunities for inclusive growth.

18. The calibration of the proposed framework is a sequential exercise (Figure 5). In a first section, we calibrate the dual-pillar framework. We start by setting a maximum debt limit above which the risks of debt distress would materially increase (*Stage 1*). Second, we estimate the total required buffer to ensure that gross debt would remain below the maximum debt limit with a high degree of confidence, based on stochastic simulations of medium-term macro-fiscal trajectories (*Stage 2*). This level of required buffer is achieved through a combination of savings accumulation and targeting of a safe gross debt level. In subsequent stages, we calibrate a savings floor that could provide self-insurance against the large fiscal effects of oil price volatility with a sufficient probability, using a value-at-risk approach (*Stage* 3). We then infer the appropriate gross debt anchor (or medium-term debt target) which would allow to achieve the required level of total buffers (*Stage 4*). In a second section, we propose a medium-term transitional fiscal path which would enable compliance with both the debt anchor and the savings floor. Box 1 provides definitions of key concepts used throughout the paper.

Figure 5. Sequencing for the Calibration of the Proposed Rules-Based Fiscal Framework in Algeria



Source: IMF staff.

Calibration of the Dual-Pillar Framework

Stage 1. Estimation of the Maximum Debt Limit

19. The first step of the calibration is to estimate the maximum debt limit, i.e. the gross debt level beyond which risks of debt distress would materially increase. This is a key reference point for estimating a "safe" debt level, which is necessarily set below the maximum debt limit to minimize the risks of breaching it. There is great uncertainty on what the level of the maximum debt limit should be and how to assess it. Several possible limits have been discussed in the empirical literature to estimate a maximum debt carrying capacity for emerging economies. These include:

- *The debt limit under the IMF's framework for debt sustainability for market access countries (MAC-DSA).* This framework sets a gross nominal debt benchmark of 70 percent of GDP for emerging market economies which was calibrated to minimize the risk of making errors in predicting stress episodes.[9]
- *The level of debt beyond which further increases would have negative effects on economic growth, leading to a feedback loop to debt dynamics.* Possible reasons for the negative effect of high debt on growth include the crowding-out of the private sector, higher exposure to risks of sudden shifts of interest-growth differentials (Lian and others 2020), or weaknesses in public debt management capacity. Reinhart and Rogoff (2010) concluded that high debt-to-GDP ratios tend to be associated with lower growth outputs in emerging countries: adverse effects become visible with a debt ratio above 60 percent of GDP and aggravated beyond 90 percent of GDP.
- *The debt level that could be sustained with the highest achievable and politically acceptable fiscal balance.* Recent IMF estimates (Caselli and others 2022)[10] show that if a typical emerging market economy can economically and politically sustain a fiscal surplus of 0.5 percent of GDP over the long run (a figure suggested by historical track record), the corresponding maximum sustainable level of debt would be 95 percent of GDP, based on pre-pandemic fundamentals. However, these simulations are highly sensitive to the assumptions made regarding interest rates, real economic growth and the elasticity of interest rates to an increase in debt. The estimated limit falls to about 70 percent of GDP, when using the higher interest rates observed in the mid-2000s rather than the record low interest rates that prevailed before the outbreak of the Covid-19 pandemic.

20. A debt limit of 70 percent of GDP would help ensure fiscal sustainability in Algeria. This estimate takes Algeria's specific macroeconomic and fiscal characteristics into account. A large

[9] The Sovereign Risk and Debt Sustainability Framework (SRDSF), which will start gradually replacing the MAC-DSA framework from this year onwards, will no longer set discrete debt thresholds and rather rely on continuous metrics, including debt levels but also other characteristics, such as the structure of debt, capacity or financing conditions (IMF, 2021b).

[10] These estimates are based on Mian and others (2022). This three-agent model – the government, a representative household and the monetary authority – approaches the debt-deficit trade-off by modelling the attractiveness of government bonds according to their safe asset features (liquidity and safety premia). The model also relies on a positive elasticity of interest rates to an increase in debt due to crowding-out effects and higher risk premia.

primary surplus is unlikely in the foreseeable future, absent further substantial increases in hydrocarbon prices, a sizeable expansion in hydrocarbon production or unrealistic consolidation efforts. Algeria's primary deficit was large at 6.5 percent of GDP in 2021, and a primary surplus has not been recorded between 2008 and 2021; the surplus in 2022 is expected to be short-lived and renewed large deficits are expected from 2023 onwards. Furthermore, Algeria's debt interest costs are expected to rise substantially in the coming years. Direct borrowing from the central bank between 2017 and 2019 and the special refinancing operation *("plan spécial de refinancement*" PSR) in 2021 have put a lid on interest costs, while posing risks to macroeconomic stability and monetary policy effectiveness. However, the authorities have committed not to have recourse to monetary financing and the PSR has expired. Hence, interest rates are expected to rise amid high inflation as the government relies increasingly on domestic market financing, creating additional fiscal pressures. The room for debt accumulation is also constrained by the limited absorptive capacity of the domestic debt market and the risk of crowding-out of the private sector, while the government is reluctant to borrow externally. Finally, the government may need to rebuild its capacity to manage debt following a long period of low market debt and foreign borrowing.

21. Still, the proposed threshold is subject to high uncertainty and should be reassessed in the future. This is because the maximum debt level that a government can sustain is not constant across time. It can vary according to a host of factors such as macro-fiscal and financial circumstances in terms of growth and interest rates, exposure to fiscal risks, sources and ease of access to financing, market perceptions, as well as debt management capacities.

Stage 2. Definition of the Aggregate Buffer to Preserve Fiscal Sustainability

22. In this stage, we estimate the size of the total buffer necessary to accommodate shocks while preserving fiscal sustainability. The starting point is a situation of full depletion of fiscal savings, in line with staff's forecasts for 2023. Under these circumstances, the total required buffer can be defined as the difference between the maximum debt limit (i.e. 70 percent of GDP as discussed in the previous step) and the starting debt level which would keep debt below the limit in the medium term, with a high probability (e.g. 95%). To compute the total buffer, we use a tool developed by the IMF's Fiscal Affairs Department (Eyraud and others 2018c). The tool estimates the joint distribution of shocks to Algeria's real GDP growth, exchange rate, interest rate and other debt drivers over the period 2009-2021. These combined shocks are then used to carry out thousands of simulations of future debt trajectories summarized in a fan chart (Figure 9). Lastly, the starting debt level is calibrated so that 95 percent of the simulated trajectories remain under the maximum debt limit over the projection horizon (i.e. the maximum debt limit is not breached with a degree of confidence of 95 percent).

23. Under the assumptions set above for Algeria, the total required fiscal buffer is estimated at 39 percent of GDP. This level of buffer could preserve fiscal sustainability over the next six years by creating sufficient fiscal space to keep debt in a safe zone, even under severe macro-fiscal shocks akin to those observed historically in Algeria. This means that if debt were at 31 percent of GDP, it is likely to be kept below 70 percent of GDP with a 95 percent confidence over a six-year horizon. The low level of the starting point for the debt stock reflects the combination of

both high exposure to shocks (i.e. Algeria's high commodity dependence) and the large magnitude of the shocks that Algeria has faced in the past (i.e. hydrocarbon price volatility).

Box 1. Definitions of Concepts Used in the Design and Calibration of the Rules-Based Fiscal Framework for Algeria

Maximum debt limit: gross debt level beyond which risks of distress would materially increase.

Safe debt level: a level of debt that is sufficiently low to ensure that debt will remain below its maximum limit in the medium term under most macro-fiscal scenarios.

Fiscal buffer: fiscal stock, in the form of liquid financial assets or sufficiently low debt liabilities relative to the maximum debt limit, and which can be used to accommodate future macro-fiscal shocks.

Total required buffer: size of the buffer which would preserve fiscal sustainability by offsetting hydrocarbon revenue downturns and maintaining debt at a safe level.

Savings floor: minimum amount of accumulated hydrocarbon revenue invested in liquid foreign assets which would provide self-insurance against hydrocarbon price shocks for a given number of years with a high likelihood. This amount is calibrated based on a value-at-risk approach (Box 2 and IMF, 2012).

Gross debt anchor: highest safe debt level, given the savings floor, to ensure that gross debt remains below the maximum debt limit in the medium term with a high probability. The anchor is calibrated using stochastic simulations of medium-term macro-fiscal trajectories. The gross debt anchor is equal to the maximum debt limit *minus* the total required buffer *plus* the savings floor.

Risk tolerance: measure of the authorities' acceptance for having a number of macro-fiscal scenarios under which the buffer would not be sufficient to prevent debt to rise above the maximum debt limit or that would require large spending cuts that could affect policy priorities.

Transition period: initial number of years during which the authorities gradually make their way to compliance with the debt anchor and savings floor without imposing an unrealistically large fiscal adjustment.

Escape clause: clause setting specific conditions and procedures under which the rules-based framework can be temporarily and exceptionally suspended in response to large exogenous shocks.

Correction mechanism: formal mechanism, triggered in cases of non-compliance with the rule(s), under which authorities are mandated to return to compliance within a reasonable timeframe.

24. The size of the required total buffer is sensitive to a number of assumptions on the authorities' preferences and policies (Appendix 1). Tolerance to risk is an important assumption—when risk tolerance is higher (e.g. the total buffer is set to ensure that debt remains below the maximum debt level in 90% of all possible simulated debt paths rather than 95%), the required total buffer is reduced. If the authorities were to have significant recourse to public private partnership arrangements or if state-owned enterprises were to face growing risks, an additional buffer should be added to offset the potential realization of these new contingent liabilities. Finally, the analysis can be considered on a different timeframe—if the aim of the buffer is to preserve sustainability after a period of ten years instead of six, its size would increase, as macro-fiscal uncertainty grows over time.

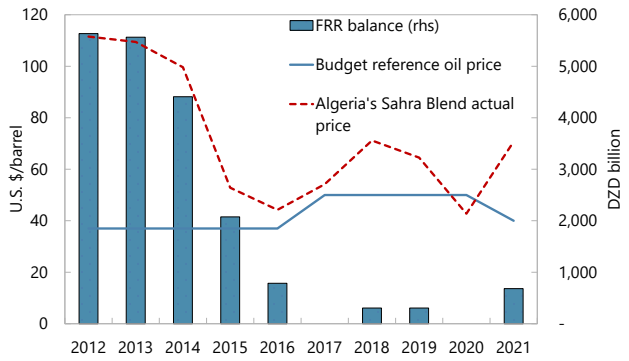
25. In a resource-rich economy like Algeria where revenues derived from hydrocarbons are both large and volatile, the total buffer of 39 percent of GDP does not necessarily need be

achieved only by constraining the debt level but could rely on the combination of a savings floor and the targeting of a safe gross debt level. The savings fund would cushion public finances against oil price shocks and help smooth revenue volatility in the medium term. This fund could hence help achieve a portion of the required total buffer; the rest of the total buffer would then need to be embedded in the setting of a safe medium-term debt target, which would be distant enough from the maximum debt limit to avoid overshooting it with high probability. We discuss the savings floor in Stage 3 and the debt anchor in Stage 4.

Stage 3. Calibration of the Savings Floor

26. Building on the current practice in formulating Algeria's annual budgets, the fiscal savings mechanism could be premised on an oil price-smoothing rule. The Algerian budget's reference oil price is currently set discretionarily at a level well below projected market prices. However, this reference price does not appear to be factored in the design of the budget: although actual oil prices have exceeded budget reference prices by a very large margin in all years but 2020, the balance of the FRR has dropped continuously since 2012 until its full depletion in 2017 (Figure 6).

Figure 6. Budget Reference Oil Prices and the FRR Balance



Sources: Ministry of Finance, OPEC, IMF staff

27. Under the proposed fiscal framework, the budget's reference oil price would be defined based on a moving average of past realizations.[11] The difference between budgeted hydrocarbon revenue based on the reference price would then result in transfers to, or withdrawals from, the fund, after the transition period during which the savings buffer is built up to the minimum floor level. This framework would decouple, to some extent, fiscal revenue and spending from immediate oil price volatility, striking a balance between the objective of stabilizing spending and the imperative of adjustment to market conditions. Oil price gyrations would still seep through to public finances and adjustment to permanent shocks will remain unavoidable, but the transmission to the budget would occur only gradually, helping to smooth spending adjustment over time. A moving-average price-smoothing rule would also have the merit of being simple, transparent and easy to communicate.

[11] Futures settlement prices can be also incorporated to add a forward-looking component, but this would put more weight on more recent realizations given the well-documented co-movement between spot and futures oil prices.

28. For the insurance mechanism to be effective, the savings fund should be invested in foreign assets. This is because the value of domestic assets is likely to be negatively affected by the oil price shocks against which the government aims to insure itself.

29. The fund should be sufficiently large to stabilize spending for a given number of years with a high likelihood. We built a value-at-risk model to calibrate the initial required minimum size of the savings fund, following the approach presented in IMF (2012) and Bartsch (2006)—see Box 2 for details. As shown in Figure 7, the model simulates thousands of alternative oil price trajectories and derives the corresponding budgeted oil revenue under an oil-price smoothing rule and realized oil revenue under Algeria's fiscal regime. It then produces an estimate of the minimum initial size of the savings buffer that would be sufficient, once the price-smoothing rule comes into effect, to offset revenue shortfalls caused by oil price fluctuations over the forecast window, while ensuring with a sufficient degree of confidence that assets would not be depleted and consequently, spending cuts would not be required. The main features of the model are presented in Box 1.

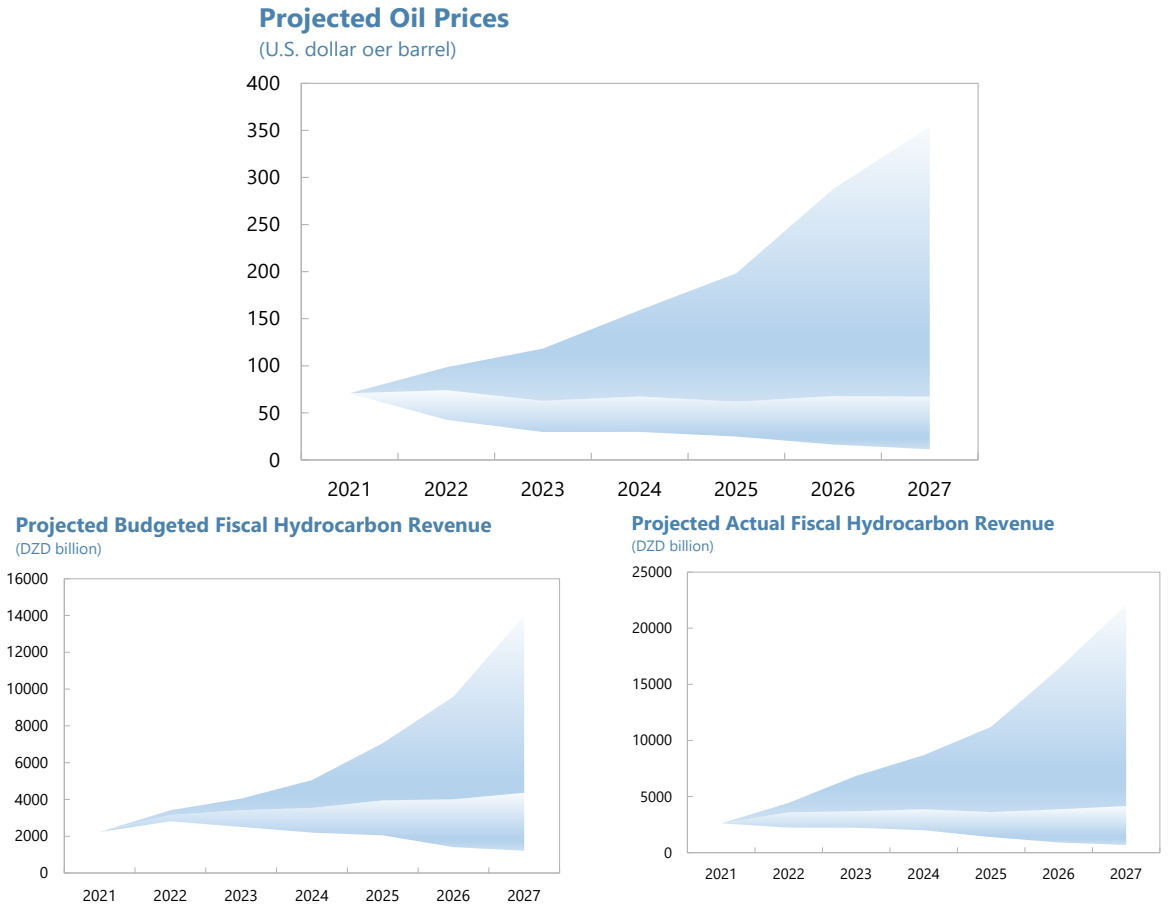
30. The size of the fund is influenced by exogenous parameters which would reflect the authorities' possible preferences for self-insurance and the underlying tradeoff between the desired level of insurance and the opportunity costs of savings. These parameters mainly include:

- *The averaging period for the price-smoothing rule*. The length of the averaging period used in the calculation of reference oil prices reflects a tradeoff between the level of savings and spending volatility. The longer the averaging period, the more stable budget hydrocarbon revenue and the higher the level of savings that should be maintained for insurance against future shocks. We run the model under the alternative assumptions of 3, 5 and 8-years backward-looking moving averages, for illustrative purposes.
- *The insurance period or dissaving horizon*. The length of the period of spending smoothing is also important for the size of the fund. The longer the coverage period, the higher the required savings level. For illustrative purposes, we retain two alternative assumptions of an insurance period of 3 and 6 years.
- *The authorities' risk tolerance*. The model estimates the initial level of the savings fund required to ride out oil price volatility *for a given predefined probability*. This parameter captures the authorities' degree of risk tolerance. The higher the probability, the lower the authorities' risk tolerance and the larger the size of the fund. We perform the analysis under the alternative assumption that the buffer should be of sufficient magnitude to cover any revenue shortfall with a probability of 80 and 90 percent.

31. We find that under a five-year moving average price smoothing rule, a savings fund of DZD 3,600-5,300 billion (16-24 percent of 2021 GDP) would be sufficient to insure Algeria against abrupt adjustment to spending over six years with a high probability of 80-90 percent. This would be equivalent to 1.4-2.0 years of annual budget hydrocarbon revenue. Reducing the insurance period to three years requires an initial savings buffer of DZD 1,600-4,700 billion depending on the oil-price smoothing rule and the degree of confidence (7-21 percent of

GDP). The size of the buffer would increase if the authorities had a preference for more stability and would rather lengthen the averaging period under the price-smoothing rule to 8 years; it would be reduced if they tolerated greater volatility and cut the averaging period to 3 years. The main results of the model under alternative sets of assumptions are summarized in Tables 1 and 2.

Figure 7. Simulated Oil Price Trajectories and Fiscal Hydrocarbon Revenue



Source: IMF staff.

32. Our results are of similar magnitude to savings currently maintained by other hydrocarbon exporters as well as with the recommendations of other papers (Figure 8). The median level of assets held by sovereign wealth funds in a sample of 22 hydrocarbon exporters represented 40.5 percent of GDP at end-2021. Based on a similar VaR approach to the one developed in this paper, IMF (2012) recommends a minimum buffer of 48 percent of non-oil GDP for the Republic of Congo. Bartsch (2006) finds that for Nigeria, a fund of US$16-18 billion (17.6 percent-20 percent of the 2004 non-oil GDP) would be sufficient to bring the probability of a fiscal crisis within five years to a manageable level. IMF (2015) estimates that net financial assets of around 2 years of annual resource revenue would be needed for Angola, Russia and Saudi Arabia to cover half of the revenue loss from commodity price fluctuations over five years.

Box 2. A Value-at-Risk Model to Calibrate Algeria's Savings Buffer

We estimate the minimum required size of Algeria's savings buffer by developing a value-at-risk model, following the approach presented in IMF (2012) and Bartsch (2006). This calibration methodology relies on stochastic simulations of oil price trajectories and the corresponding fiscal hydrocarbon revenue under Algeria's fiscal regime and hydrocarbon production profile.

The main assumptions and equations are as follows:

- Oil prices are assumed to follow a first-order autoregressive process, under which oil prices in a given year are a function of their past year's value and a random term (ε_t): $P_t = \alpha + \beta \log(P_{t-1}) + \varepsilon_t$ where P_t denotes the logarithm of oil prices in year t.
- The model parameters are estimated based on data published by British Petroleum over the period 1976-2021. We include dummy variables to control for possible structural changes in oil markets during episodes identified by Baumeister and Kilian (2016), and namely the Iranian revolution in 1979/1980 and the Iran/Iraq war in 1980-1988. The inclusion of dummies for the first Gulf war in 1991, the Great Financial Crisis and the outbreak of the Covid-19 pandemic did not yield statistically significant results.
- We then estimate 10,000 oil price trajectories using a bootstrapping procedure and setting the 2021 actual outturn as the starting value. The trajectories are estimated for alternative periods of 3 and 6 years.
- Both budgeted fiscal hydrocarbon revenue HR_t^b and actual fiscal hydrocarbon revenue HR_t^a are estimated based on the forecasts for hydrocarbon production volumes and the Algerian dinar's exchange rate included in staff's baseline scenario and assuming an unchanged fiscal regime in the hydrocarbon sector. Budgeted hydrocarbon revenues are estimated under an oil price smoothing rule whereby budget reference oil prices are alternatively calculated as a moving average of past realizations over 3, 5 or 8 years.
- Transfers to and from the savings fund T_t are calculated as the difference between budgeted and actual fiscal hydrocarbon revenue: $T_t = HR_t^a - HR_t^b$
- In any given date, the balance of assets held in the savings fund S_t is a function of its value in the previous year, the yield on the previous year's holdings and transfers during the present year: $S_t = S_{t-1} * (1 + \delta) + T_t$, where δ is the annual yield realized on the fund's investment.

The required initial size of the fund S_0 is calculated as the minimum starting amount that would avoid a full depletion of the fund at the end of the projection window with a given level of confidence (set alternatively at 80 and 90 percent).

Stage 4. Calibration of the Gross Debt Anchor

33. Based on the size of the total buffer and required savings floor, the gross debt anchor can now be inferred. If part of the total required buffers computed in Stage 2 (39 percent of GDP) is covered by the savings floor computed in Stage 3, the rest should then be embedded into a "safety margin" under the maximum debt limit needed to calibrate the debt anchor. While the buffers might not be strictly additive per se, our country-specific approach is to sum them given the nature of the shocks that affect Algeria's debt, public finances, and economy. The debt calibration tool used to estimate the size of the total buffer draws on the past distribution of real GDP growth, the exchange rate, the interest rate and other debt drivers. Given the high reliance of Algeria's budget on oil revenue and the large footprint of the public sector in the economy, these shocks

reflect, to a large extent, fluctuations in oil prices. This means that the savings buffer, estimated through a model squarely centered on oil price shocks, can be deducted from the total buffer: risks from oil price volatility are insured against by building a savings buffer while the debt buffer (or safety margin under the maximum debt limit) protects residual shocks.

Table 1. Algeria: Minimum Required Size for the Asset Buffer (DZD bn and Percent of GDP)

DZD bn *(in percent of GDP)*	Insurance (dissaving) period	3 years		6 years	
	Degree of confidence	*80 percent*	*90 percent*	*80 percent*	*90 percent*
Oil price smoothing rule	3-year moving average	**1600** *(7.3)*	**2300** *(10.4)*	**1900** *(8.6)*	**2900** *(13.2)*
	5-year moving average	**2800** *(12.7)*	**3800** *(17.3)*	**3600** *(16.3)*	**5300** *(24.1)*
	8-year moving average	**3600** *(16.3)*	**4700** *(21.3)*	**5800** *(26.3)*	**8400** *(38.1)*

Source: IMF staff.

Table 2. Algeria: Minimum Required Size for the Asset Buffer (Relative to Budget Hydrocarbon Revenue)

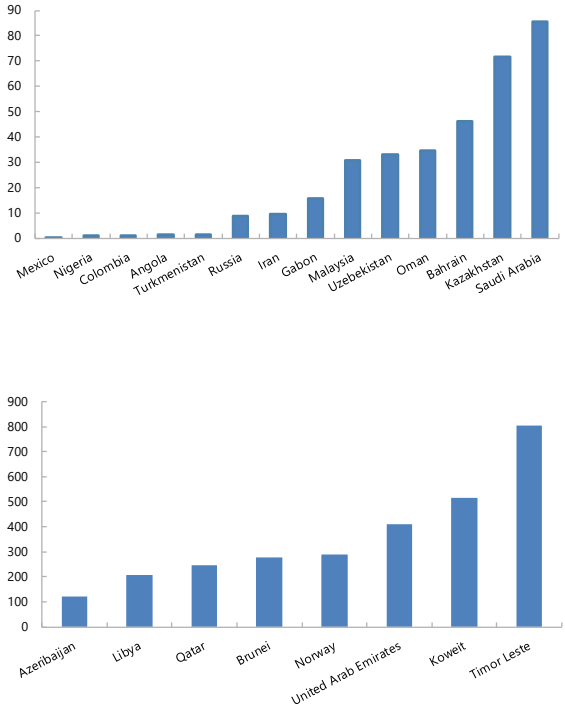
Relative to budget hydrocarbon revenue (years)	Insurance (dissaving period	3 years		6 years	
	Degree of confidence	*80 percent*	*90 percent*	*80 percent*	*90 percent*
Oil price smoothing rule	3-year moving average	**0.6**	**0.9**	**0.7**	**1.1**
	5-year moving average	**1.1**	**1.5**	**1.4**	**2.0**
	8-year moving average	**1.4**	**1.8**	**2.2**	**3.2**

Source: IMF staff.

34. The relevant gross debt anchor depends on the authorities' preference for savings. Table 3 proposes three possible calibrations, given the same total required buffer, depending on the authorities' preference regarding their level of self-insurance against hydrocarbon price shocks. The higher the preference for savings, the higher the gross debt anchor. Yet, a "balanced" approach could be to set the gross debt anchor at 48 percent of GDP and the savings floor at 16 percent of GDP (Figure 9).

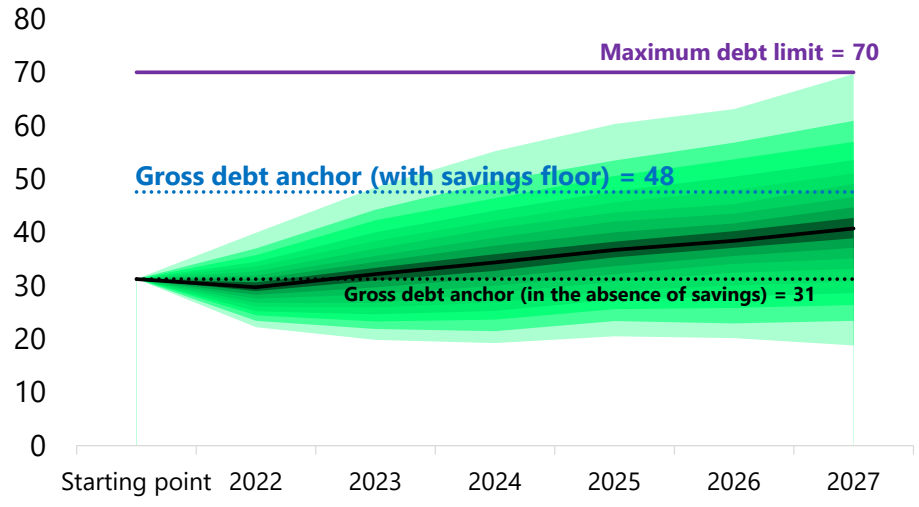
This proposal is deemed realistic based on past FRR balances and the size of the adjustment needed to get to the anchor in the medium run. Overall, this framework would provide Algeria with the necessary space to accommodate the macro-fiscal effects of most shocks into the medium term (six years), even severe (95% probability). The savings floor would insure Algeria against abrupt fiscal adjustment over 6 years with a probability of 80 percent, under a price-smoothing rule based on a 5-year averaging period. Appendix 1 provides indications on the sensitivity of the gross debt anchor to changes in model assumptions (see also §24).

Figure 8. Assets Under Management in Sovereign Wealth Funds (% GDP, 2021)



Sources: Global Sovereign Wealth Fund 2022 Report, IMF staff calculations

Figure 9. Proposed "Balanced" Calibration of the Rules-Based Fiscal Framework



Source: IMF staff.

Table 3. Algeria: Examples of Possible Calibrations of the Gross Debt Anchor and Savings Floor

(Percent of GDP)	Calibration 1 (larger savings)	Calibration 2 ("balanced")	Calibration 3 (smaller savings)
Maximum debt limit **(1)**	70	70	70
Total buffer **(2)**	39	39	39
Savings floor **(3)**	24 *(6-y insurance, 5-y moving average, 90% degree of confidence)*	16 *(6-y insurance, 5-y moving average, 80% degree of confidence)*	9 *(6-y insurance, 3-y moving average, 80% degree of confidence)*
Gross debt anchor **= (1) – [(2) – (3)]**	56	48	40

Source: IMF staff estimates.

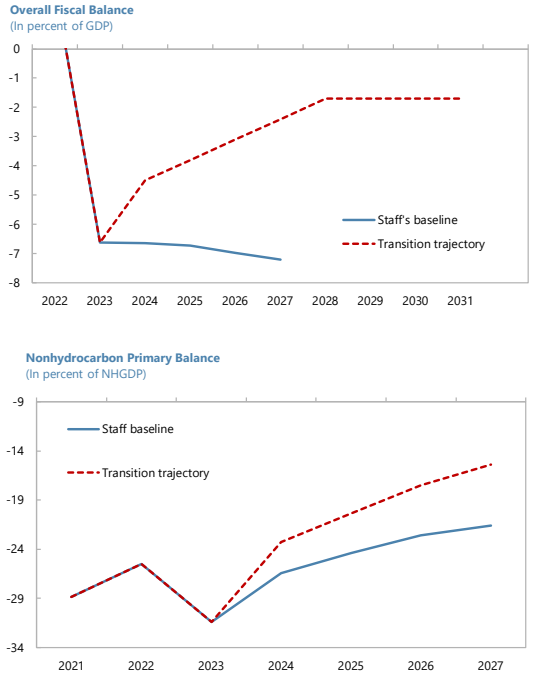
Calibration of the Transitional Fiscal Path to Compliance

35. A multi-year transition is needed before the authorities can realistically comply with the framework. Given Algeria's large non-hydrocarbon fiscal deficit, rising debt and thin fiscal savings, and despite the hiatus in 2022, a sufficiently long transition period is required to avoid an unrealistically large fiscal adjustment. For example, the government could aim to achieve compliance with both the debt and the savings objectives within a timeframe of 8 years, following a five-year adjustment period – this means building up a total buffer of 39 percent of GDP in the next 8 years. To do so, the authorities would need to accumulate savings, depending on their preference for self-insurance, and find the relevant non-resource fiscal balance trajectory which would allow to comply with the associated gross debt anchor. Under current macro-fiscal assumptions, this would necessitate an improvement in the non-hydrocarbon primary deficit excluding Bank of Algeria's dividend by [0 percent of NHGDP relative to its projected level at end-2022 and by 2027, which, based on the current forecast oil prices, would result in an additional narrowing in the overall fiscal deficit by 4.8 percent of GDP relative to its projected level in 2027 under staff's baseline scenario, and a deficit of around 1.7 percent of GDP from 2028 onwards, as illustrated in Figure 10. This deficit trajectory would allow the authorities to save around 1.4 percent of GDP in hydrocarbon revenue in the asset fund per year until the targeted savings floor is reached.

36. The transitional path is conditional on relatively high price trajectory. It is predicated on the assumption that global benchmark oil prices will average USD 77/barrel in 2022-2027, versus an average of USD 69.3/barrel over the previous decade. However, should hydrocarbon revenue surprise on the upside relative to staff's baseline scenario, the authorities could accelerate asset accumulation and save the windfall gains, allowing for lower fiscal balance target in the outer years of the transition period. Conversely, if oil prices fall below the assumed trajectory, the authorities could consider temporarily relaxing efforts towards bringing the debt towards the medium-term anchor, by allowing a lower overall fiscal balance, and prioritize savings accumulation, given that Algeria's debt level is moderate while its asset buffers are merely depleted. However, they should still adhere to the calibrated trajectory for the non-hydrocarbon balance, to ensure a resumption of progress towards the medium-term

objectives, once prices recover. The transition path would need to be recalibrated and lengthened if oil prices fall substantially and durably below the assumed trajectory: the authorities could call on the escape clause (see §40) and make use of the savings accumulated in the fund so far to offset part of the fall in revenue, if oil prices move significantly below their historical average.

Figure 10. Proposed Fiscal Paths in the Transition Period
(Percent of GDP)



Source: IMF staff.

37. In the medium term, a set of operational rules and targets would be required to support compliance with both objectives. After the transition period, the oil-price smoothing rule could enter into full effect: the difference between actual and budgeted hydrocarbon revenue based on a reference price set as the moving five-year average of past realizations would be transferred to the fund or withdrawn from it.[12] Concurrently, to maintain compliance with the debt anchor once it is reached, an operational rule, typically a ceiling on the non-resource deficit or on expenditure, should be included in the framework. In case of conflict between the two operational rules, the authorities should aim for compliance with the strictest of the two, to preserve the credibility and efficiency of the framework. Given the medium-term uncertainty, the full design of operational rules can be decided in a few years, once the authorities get closer to complying with the fiscal objectives.

D. Ensuring Effectiveness of the Rules-Based Fiscal Framework

38. As the calibration of the buffer is sensitive to a set of assumptions, it is good practice to set a *rendezvous* clause for the review of the framework, after three to five years. Such a clause would require that the authorities assess the pertinence of the framework and the chosen calibration—changes might indeed be required if new macro-fiscal conditions have arisen. In the medium term, once a sufficient level of gross savings has been accumulated and gross debt brought down, the Algerian authorities could consider a single « net » anchor on the difference between gross debt and the savings fund's assets, which would provide them with more flexibility to arbitrate between debt accumulation and asset drawdown (e.g. this could allow for higher gross debt, as long as savings are also higher).

[12] In the later years of the transition period, authorities should gradually phase in the smoothing rule to avoid threshold effects, depending on the oil price trajectory.

39. In its design, the discussed framework also needs to strike an appropriate balance between simplicity, flexibility and enforceability. Pursuing these multiple objectives often entails difficult tradeoffs. For example, while they should sufficiently constrain fiscal policies to be effective and credible, fiscal rules should also be sufficiently flexible to allow for countercyclical fiscal policy when needed, whether in the face of normal business cycles (letting automatic stabilizers operate) or of extraordinary shocks (allowing for the temporary suspension of the rules).

40. The authorities could consider the adoption of an escape clause, which would allow for a temporary and exceptional suspension of the framework (including during the transition period) in the event of very serious shocks or when a large fiscal intervention is needed. Escape clauses are very common instruments, found in more than 80 percent of fiscal rule frameworks across the world, as per the IMF Fiscal Rules dataset. Close to 40 percent of countries with a fiscal rule have activated an escape clause following the COVID-19 pandemic (Davoodi and others 2022). This has enabled the adoption of large stimulus packages, while preserving the integrity of the fiscal rule frameworks. To avoid impeding the credibility of the rule, escape clauses need to be clearly defined at the time of the adoption of the fiscal rule framework, with at least a precise definition of the conditions under which the clause can be activated (e.g. nature and magnitude of shocks, time limits on the duration of its activation (or at least regular mandatory reassessments of whether the clause should stay active or not), requirements to return to the targets once the operation of the escape clause is terminated, and institutional responsibilities for the activation and monitoring of the clause. Box 3 provides examples of escape clauses, including in a few resource-rich countries.

41. Credibility and enforcement can be enhanced by correction mechanisms for getting back to compliance after a breach of the rule. Because of unexpected macroeconomic shocks which might affect fiscal aggregates, the authorities might be temporarily unable to comply with the rules or stick with the transitional path, for instance if revenue collapses late in the fiscal year with no time to react, or when needing to increase emergency spending in response to a shock. To ensure that the framework remains credible, the Algerian authorities could envisage correction mechanisms which impose the return to compliance within a reasonable timeframe, while avoiding sharp adjustments which might negatively affect the economy. These mechanisms vary in sophistication and level of constraint. In Panama, for instance, when the fiscal target is not reached, the government is simply required to publish a detailed explanation on why it failed to reach the target, and which fiscal adjustments are needed to resume compliance. A more sophisticated and stringent example (Slovakia) is provided in Box 4.

42. Assigning responsibilities for the appropriate monitoring of the rules' implementation is critical to their enforceability, including during the transition path. One should distinguish between *ex ante* compliance (i.e. the fiscal strategy and budget adopted every year is consistent with the fiscal rules) and *ex post* compliance (i.e. the rules have been effectively complied with, based on fiscal outturns). Responsibilities for *ex ante* compliance typically land within the agency or department within the Ministry of Finance in charge of leading the establishment of the fiscal strategy—the idea being that the proposed fiscal strategy should be consistent with the rules. To

ensure *ex post* compliance, this agency or department should also carefully monitor budget execution and keep track of possible deviations. Both the *Direction Générale du budget* and the *Direction Générale de la Prévision et des Politiques* could be tasked with this monitoring. Access to reliable, frequent infra-year fiscal data is critical—only then can the government proactively react in case *ex post* compliance with the rule is threatened.

Box 3. A few Examples of Escape Clauses

Colombia: according to the 2021 Social Investment Law (Ley No. 2155), Article 60, the escape clause will allow for a temporary deviation from compliance with the fiscal targets set by the rule (on debt and on the structural primary balance) "in the event of extraordinary events, or events that compromise the macroeconomic stability of the country". The clause can be activated by an internal council on fiscal policy headed by the Finance Minister, and subject to a non-binding opinion by a new Autonomous Committee of the Fiscal Rule. The National Government shall regulate the operation of the clause, including the maximum duration of the deviation, its magnitude, and the path of return to full compliance with fiscal targets.

Peru: The application of fiscal rules (ceiling on real expenditure and 1 percent fiscal deficit ceiling) may be suspended for up to three years when (a) real GDP is declining, with the ceiling on the deficit being raised up to 2.5 percent of GDP, with a minimum annual reduction of 0.5 percent of GDP until the 1 percent deficit ceiling is reached; and (b) in other emergencies declared by the Congress at the request of the Executive. The Executive must specify in its request the ceilings to be applied during the period of exception for the deficit and expenditure rules, with the minimum annual reduction of 0.5 percent of GDP on the deficit applying also in this case.

Jamaica: the debt and fiscal balance rules could be deviated on the grounds of national security, national emergency, or such other exceptional grounds, as the Finance Minister may specify in an order subject to affirmative resolution. It also had a correction mechanism, whereby annual deviations are stored in a notional account. When this exceeds a threshold, annual adjustments have to be implemented to get back to the fiscal rules.

Source: IMF Fiscal Rules dataset.

Box 4. Example of Correction Mechanism: Slovakia

In Slovakia, a constitutional bill which caps public debt at 60 percent of GDP has been in effect since 2012. Automatic sanction mechanisms take effect when the debt-to-GDP ratio reaches 50 percent. In such a situation, the Minister of Finance is required to clarify the increase to parliament and suggest measures to reverse it. At 53 percent of GDP, the cabinet shall pass a package of measures to trim debt and freeze civil service wages. At 55 percent, expenditures shall be cut automatically by 3 percent and next year's budgetary expenditures shall be frozen, except for interest payments and other certain types of expenditure. At 57 percent of GDP, the cabinet shall submit a balanced budget. Should the debt climb to 60 percent of GDP, the cabinet would face a confidence vote in parliament.

Source: IMF staff.

43. Institutional mechanisms aimed at discouraging non-compliance could also be envisaged. Many countries having adopted fiscal rules have faced situations of non-compliance. In national settings, formal sanction mechanisms have proven largely ineffective; mechanisms creating reputational costs when breaching the rules have hence become a better way to encourage

compliance. On top of correction mechanisms described above, the two following mechanisms could be explored by the Algerian authorities:

- ***Reporting on compliance.*** The legislature and the public should be informed of whether the rule (or agreed transition path) has been complied with over the previous reporting period, whether the proposed upcoming budget is compliant, and whether special mechanisms (e.g. escape clause, correction mechanism) have been activated. This information can be communicated through budget documentation—this would typically be embedded in a medium-term fiscal strategy, or in a dedicated report. Reporting on compliance would fit well within Algeria's ongoing fiscal transparency agenda, and could help raise awareness and trigger interest of the legislature, particularly in times of budget debates. The medium-term budget framework document attached to the budget bill would be the relevant place for such communication.
- ***Independent fiscal institution.*** About 50 countries have set up a fiscal council as of 2021 (Davoodi and others 2022). A fiscal council is a nonpartisan public entity with a statutory or executive mandate aimed at promoting sustainable public finances through assessing fiscal plans and performance, evaluating macroeconomic and budgetary forecasts, monitoring the implementation of fiscal rules, and costing of government measures (IMF 2013). They can hence be helpful in independently assessing compliance with the rules and alerting the public on potential breaches. The success of a fiscal council hinges on receiving funding and staffing commensurate with the size of its mandate, on ensuring nonpartisanship and formal independence, and with guaranteeing access all needed fiscal information on a timely basis. Setting up a fiscal council does not remove the need for internal monitoring mechanisms (¶36), which stands as a higher, more immediate priority in the case of Algeria. Algeria's supreme audit institution (*Cour des Comptes*) could alternatively be tasked with providing an opinion on fiscal rule compliance.

44. Fiscal rules require effective and robust fiscal institutions and strong political will. On top of the need for a clear political commitment to fiscal discipline, the Algerian authorities should continue to build PFM capacity as a way to support the implementation of the new rules-based framework, mainly:

- *the reinforcement of macro-fiscal capacities*. While the Ministry of Finance does produce macro-fiscal forecasts, the implementation of a set of fiscal rules requires to assess the available fiscal space on a regular basis, propose a fiscal path consistent with the rules, and be reactive to changes in the outlook. Regular publication of targets and forecasts is also needed to encourage compliance with the rules.
- *the reliance on efficient information systems*, enabling timely, frequent access to fiscal outturns. This is especially needed to enhance the quality of forecasts and to achieve effective in-year monitoring of rules. The authorities should continue setting up modern financial IT systems (SIGBUD, SIGB) that could help provide a close to real-time picture of budget execution.
- *the development of sound fiscal risk management practices*, in particular the careful management of fiscal or quasi-fiscal operations that may fall outside the scope of the rule. The materialization

of contingent liabilities, such as those associated with SOEs or public-private partnerships (PPP), might hinder compliance with the rules by causing a sudden increase in government debt. The recently established High Committee on Fiscal Risks will help better identify, analyze and manage fiscal risks weighing on public finances in Algeria. In addition to the rules-based fiscal framework proposed earlier, the authorities could also consider mechanisms aimed at mitigating certain types of risks. For instance, given the authorities' expected recourse to PPPs in the coming years, setting ceilings on either the stock or the annual flow of PPP projects would prevent excessive exposure to fiscal risk.

- *assurances on the sound governance and transparent use of the FRR*. Financial information about the FRR—balance sheet, statement of operations, types of investment, rates of return—should be reported on at least an annual basis, as part of budget documentation. The investment strategy of the FRR should be published. To ensure good governance of the FRR, the authorities should consider subscribing to the International Forum of Sovereign Wealth Funds' Santiago principles, which provide 24 practical items of guidance on appropriate governance and accountability arrangements, and the conduct of investment practices necessary for sound long-term investment procedures. [13]

E. Conclusion

45. It is the right time for Algeria to implement a well-designed, well-calibrated rules-based fiscal framework. A dual-pillar framework as the one proposed above would be an effective tool to support macroeconomic stabilization and fiscal sustainability and underpin fiscal credibility and market access. The proposed framework revolves around two objectives: (i) a savings floor, calibrated so as to self-insure Algerian public finances against hydrocarbon price shocks; and (ii) a debt anchor, or medium-term gross debt target, calibrated so as to prevent debt from reaching potentially unsustainable territory with sufficiently high confidence. A transition period of 10 years would be needed at first to comply with these two objectives; in a steady state, operational rules and targets can be designed to maintain compliance, and the oil price smoothing mechanism can enter into full effect. Mechanisms to ensure flexibility (escape clause) and compliance (correction mechanism, reporting) would be useful features to ensure the effectiveness of the framework. The adoption of such a framework should be accompanied by continued efforts to enhance macro-fiscal forecasting and budget monitoring capacities at the Ministry of Finance, so that it truly informs strategic planning, budget preparation and execution.

[13] https://www.ifswf.org/santiago-principles-landing/santiago-principles

Appendix I. Sensitivity of the Calibration to Model Assumptions

The table below provides indications on the sensitivity of the debt anchor calibration model to its key assumptions. Results below assume no change in the authorities' preference for self-insurance: savings are calibrated to insure Algeria against abrupt fiscal adjustment over 6 years with a probability of 80 percent, under a price-smoothing rule based on a 5-year averaging period.

(Percent of GDP)	*Description*	Total Required Buffer	Debt Anchor	Savings Floor
"Balanced approach"	*See §32*	39	48	16
Lower Risk Tolerance	*The total required buffer is set so as to ensure that after six years, debt remains below the maximum debt limit in 96% (instead of 95%) of simulated debt paths.*	45	41	
Time Horizon	*The total required buffer is set so as to ensure that after seven years (instead of six), debt remains below the maximum debt limit in 95% of simulated debt paths.*	54	32	

Source: IMF staff estimates.

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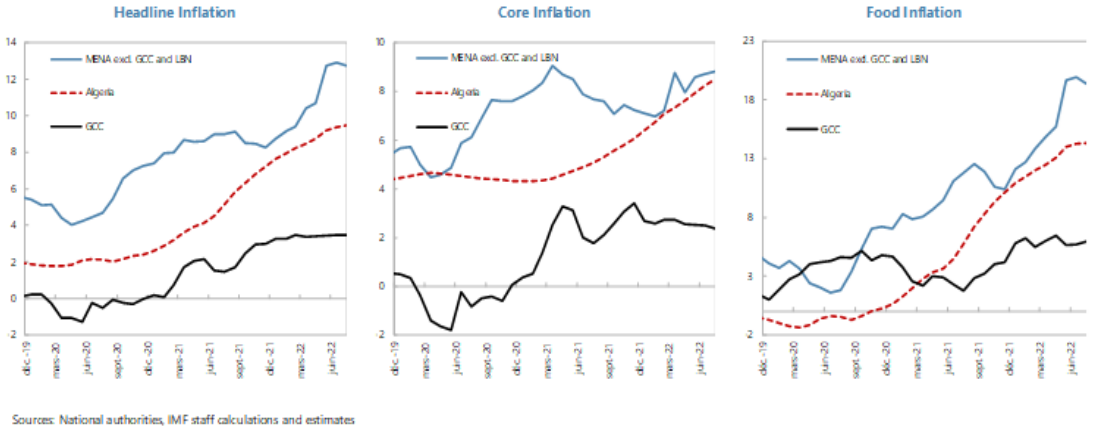
A REEXAMINATION OF INFLATION DYNAMICS AND DRIVERS IN ALGERIA[1]

A. Introduction

1. In Algeria, as in the rest of the Middle East and North Africa region, inflation is emerging as a major policy challenge (Figure 1). Headline inflation in Algeria, measured by the change in the average consumer price index (CPI), picked up in late 2020 and continued to accelerate through 2021 and most of 2022, reaching 9.5 percent in August 2022—a level not seen in twenty-five years. It later inched down to 9.2 percent in November. Core inflation, i.e., inflation excluding fresh food products and regulated prices, accelerated to a record high of 8.5 percent in August 2022, well above its long-term average of 4.5 percent. This trend has been broad-based as most sub-components of inflation, including regulated prices, have increased sharply.

Figure 1. Headline, Core and Food Inflation



Sources: National authorities, IMF staff calculations and estimates

2. High inflation poses multiple risks. Across the world, inflation has proved to be more persistent than anticipated, raising concerns about inflation expectations becoming unanchored and undermining central banks' success in taming inflation in the last few years. There is also ample evidence that high inflation is associated with lower growth, including because of its effect on investor confidence and incentives to save, as well as its deleterious impact on financial stability (IMF, 2001; Mishkin, 2008). Importantly, the harmful effects of inflation are more acute on lower income groups who have fewer assets which they can draw down when faced with rising prices (Ha, Kose and Ohnsorge, 2019). The Algerian authorities have implemented several measures in 2022 to

[1] Prepared by Mahmoud Harb and Priscilla Muthoora (all MCD). Jarin Nashin has provided excellent research assistance.

protect households against rapidly rising living costs (*see the staff report for the 2022 Article IV consultation with Algeria*).

3. Recent policy debates have focused on the respective roles of supply and demand factors in explaining the recent bout of global inflation.[2] Output and prices tend to move in the same direction following demand shocks but tend to be negatively correlated following supply shocks (Blanchard and Quah, 1989). As such, inflationary demand and supply shocks raise a different set of challenges for central banks. Monetary policy tightening in response to demand shocks is an obvious policy reaction to attempt to stabilize both output and prices. However, in response to supply shocks, monetary policy is confronted in the short run with a more difficult tradeoff between the imperatives of preserving price stability and protecting growth. Prior to the pandemic, it was generally accepted that central banks can accommodate supply shocks without endangering price stability provided that inflation expectations remain well-anchored, that the shock is temporary and does not lead to second-round effects on prices.

4. The experience of the Covid-19 pandemic has prompted a reconsideration of the appropriate monetary policy response to supply shocks. The post-pandemic experience has indeed shown that supply shocks might give rise to second round effects rapidly and require a proactive monetary policy response. This is particularly the case if the shock is large in magnitude and spills over from initially affected sectors to other sectors and if price pressures had been on the rise prior to the shock, weakening the anchoring of inflation expectations (Gopinath 2022).

5. In Algeria, monetary policy has remained accommodative. The Bank of Algeria (BA) has kept its policy interest rate and the reserve requirement ratio unchanged since May 2020 and February 2021 respectively. Both had been lowered to record low levels in response to the pandemic shock. Reflecting an accommodative monetary policy stance, the interest rate on the interbank market remained low, at around 0.5 percent for the shortest tenures in 2022. The central bank's strategy is based on its view that monetary policy tightening would have limited effectiveness against price pressures stemming mostly from external cost-push factors but could harm growth, at a time when the economy is gradually emerging from the pandemic shock, and credit to the private sector remains subdued. Hence the BA allowed a 10.7 percent appreciation in the nominal effective exchange rate (NEER) over the first eleven months of 2022, which it expects to help reduce price pressures in the near term. Meanwhile, considerable fiscal policy easing has been announced for 2023 to boost purchasing power and growth.

6. In this context, understanding the dynamics of inflation and its recent drivers is important to inform monetary policy. The objective of this paper is to assess the recent drivers and risks of persistence of the recent dynamics of inflation in Algeria. A better understanding of the relative importance of demand and supply factors, whether domestic or external, in driving the acceleration in inflation is critical to inform policy choices. The paper employs several complementary approaches. A univariate analysis sheds light on the trend in inflation as well as on

[2] See, for example, Adrian and Gopinath (2021).

the role of seasonal factors and exogenous shocks in driving price dynamics. The relative importance of concentrated supply-side sectoral shocks is assessed by analyzing the correlation between inflation and the skewness of relative price changes. Finally, a multivariate analysis based on a triangular augmented Phillips curve provides empirical evidence on the role of demand and supply factors in driving headline inflation and its various subcomponents, and on the persistence of inflation in Algeria. These complementary approaches are followed to circumvent the challenges in the analysis arising from the concomitance of significant shocks and policy shifts, the absence of survey-based or market-based measures of inflation expectations and the lack of data on the labor market and wage dynamics since 2019.

7. Our analysis points to risks of inflation persistence in Algeria due to a confluence of external and domestic supply shocks, exacerbated by domestic demand factors. The analysis highlights a broad-based acceleration in trend inflation prior to the current commodity price shocks, underscoring risks of persistent inflationary pressures and de-anchoring of expectations. While the role of external supply factors in driving the rise in inflation is significant, the impact of domestic factors appears to be larger. Some pertain to temporary exogenous developments, for example a drought in 2021, while others could be related to more entrenched factors, such as disruptions to retail markets and trade regulation measures. Although data limitations create uncertainty around point estimates, the results not only suggest cost-push factors have played a significant role in fueling inflation but that demand-pull forces are also at play.

8. These findings suggest highlight the need for swift monetary policy tightening to tame inflation. Broad inflationary pressures prior to the current shock, and inertia highlights the need for withdrawal of current monetary accommodation. Despite data limitations, there are indications that the output gap has substantially narrowed and perhaps even fully closed. Substantial fiscal easing announced under the 2023 budget might add to demand pressures. Public-sector wage increases in 2022 and 2023 might contribute to self-reinforcing price pressures.

9. The rest of the paper proceeds as follows. First, we discuss some stylized facts about inflation based on the results of the univariate and skewness of relative prices. Then, we present our empirical strategy and the results for the Phillips curve estimation. We discuss policy implications in the final section of the paper.

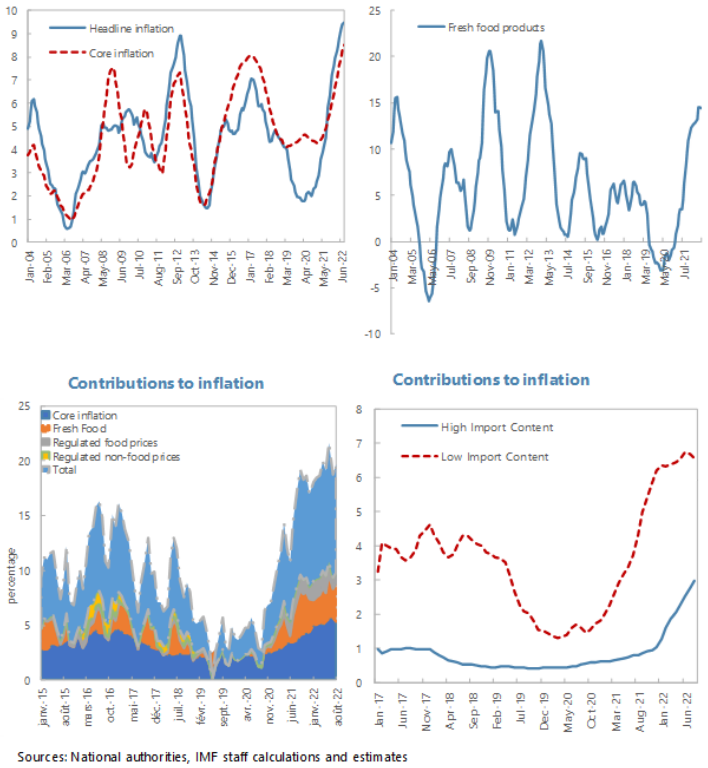
B. Inflation Dynamics in Algeria: Stylized Facts

10. Algeria is currently experiencing the third episode of high inflation in two decades. During the first episode, annual headline and core inflation peaked at 8.9 percent and 7.3 percent respectively in January 2013, in the wake of the 2011 commodity price shock and large wage increases in 2012. Inflation subsequently receded rapidly in 2013. During the second episode, inflation rose to 7.1 and core inflation reached 8 percent in March 2017 against the background of direct monetary financing of the deficit, a large depreciation of the dinar in 2016, a rise in the VAT

rate and increases in regulated gasoline prices.[3][4] During the current episode, inflation has exceeded its previous peaks, with headline inflation rising to 9.5 percent and core inflation to 8.5 percent at end-August 2022. Inflation eased slightly to 9.2 percent at end-November, mostly owing to slower increase in the prices of fresh produce, poultry and edible oil which had surged in the previous year. This offset further acceleration in most other CPI components.

11. The recent acceleration in inflation has been broad-based. Headline inflation has risen steadily since the end of Q3:2020, when the economy started to emerge from the first phase of the pandemic crisis, first driven by higher food prices and then by the acceleration in non-food prices. Between its end-September 2020 trough and August 2022, inflation accelerated by 7.5 percentage points, to 9.5 percent. Around 3.6 percentage points were due to fresh food products and 2.4 percentage points were due to core inflation. Regulated food prices contributed 1.4 percentage points to headline inflation despite an absence of official price hikes and the adoption of measures to broaden the scope of food subsidies following the 2022 commodity price shock. This could possibly suggest anticipations of higher inflation, attempts to avoid a compression in margins or disruptions to domestic supply.

Figure 2. Consumer Price Inflation
(12-Month Average CPI, YoY Percent Change)



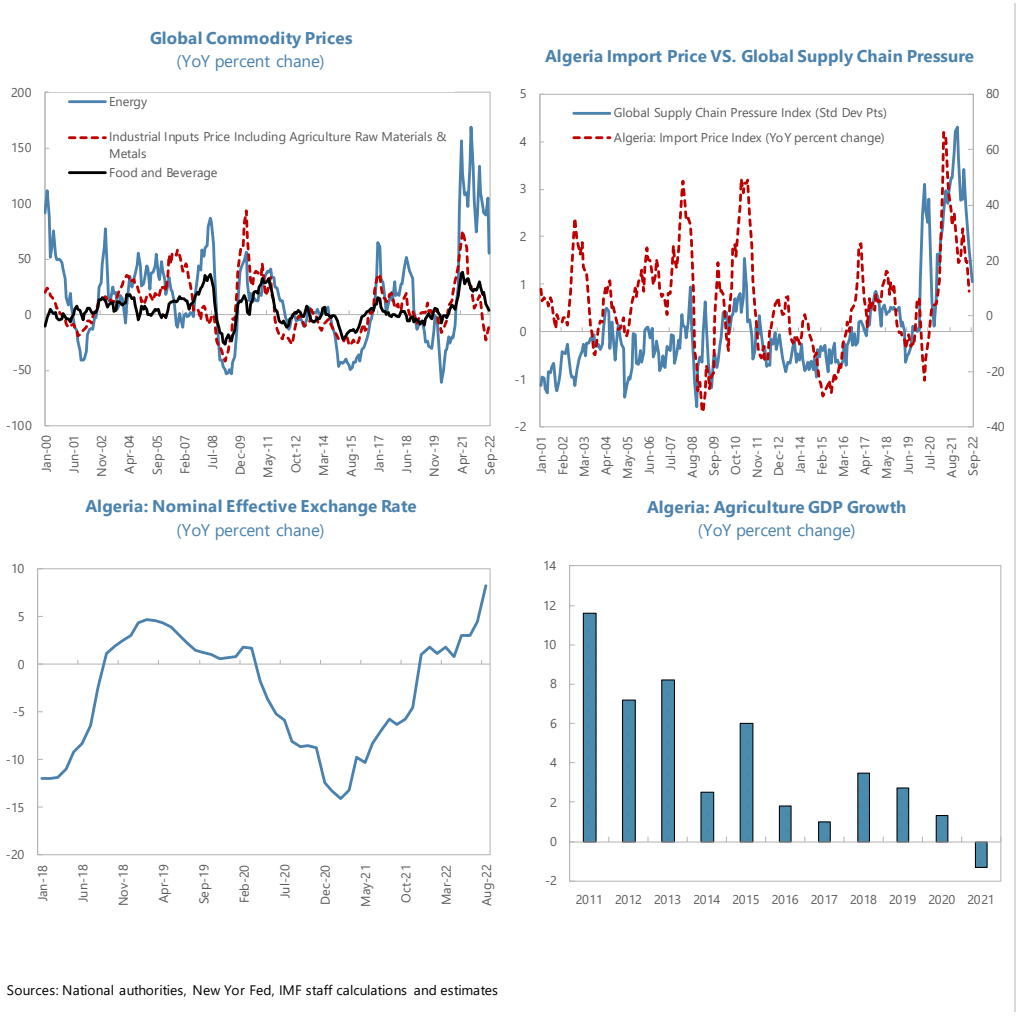
Sources: National authorities, IMF staff calculations and estimates

[3] See the 2012, 2013 and 2017 staff reports for the Article IV consultation with Algeria for further discussions of inflation dynamics and drivers in recent years.

[4] Gas prices nonetheless remained heavily subsidized. Inflation subsided in early 2018.

12. External supply factors explain only part of the recent acceleration in inflation. On the supply side, a range of global cost-push factors might have caused price pressures. After the first stages of the Covid-19 outbreak, disruptions to global supply chains continued, the cost of international goods transport rose, and commodity prices bounced back with their rally accelerating after the start of the war in Ukraine (IMF October 2022 WEO). The impact of the rise in import prices was likely amplified by a 13.3 percent depreciation in the dinar's nominal effective exchange rate (NEER) between 2019 and 2021. Reflecting these external developments, import-intensive goods contributed around 2.4 percent to the acceleration in inflation between September 2020 and August 2022. This is, however, less than one-third of the acceleration in total inflation over that period, pointing to more domestic origins of price pressures.

Figure 3. A Range of External and Domestic Cost-Push Factors

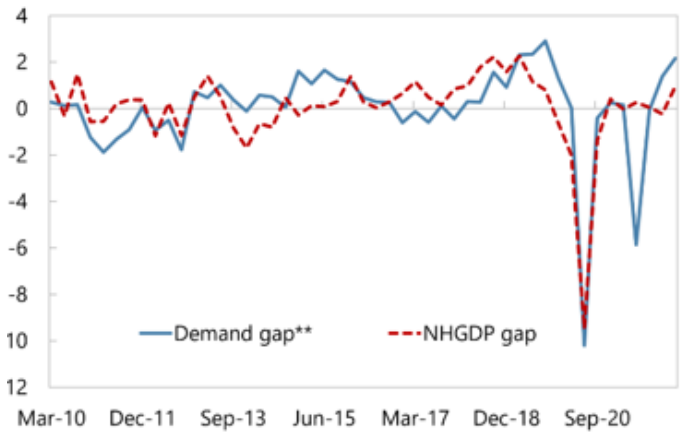


Sources: National authorities, New Yor Fed, IMF staff calculations and estimates

13. Domestic factors have amplified the impact of external cost pressures on inflation. On the supply side, severe drought conditions prompted a rare outright contraction in Algeria's crop

production in 2021, contributing to a rise in the prices of food products. Tight import regulation measures might have affected supply. There were frequent reports of domestic supply disruptions which the authorities have attributed to hoarding and speculation. [5] The reopening of the economy in the second half of 2020 as sanitary restrictions were lifted constituted a dual positive shock to both supply and demand, with an ambiguous net impact on inflation. A loose policy stance might have resulted in demand-induced pressures on prices as monetary policy remained accommodative through most of 2022. There are indications that the output gap was fully closed in Q1:2022 (Figure 4), despite uncertainty around these estimates as output gap is notoriously hard to measure and statical filtering techniques used to estimate trend GDP present well-known limitations (Orphanides and Van Norden 2002). Announcement of subsidy reform in the 2022 budget law might also have contributed to expectations of higher inflation.

Figure 4. Output Gap*
(In Percent of Trend GDP)



*Calculated based on Hodrick-Prescott filter
**Computed analogously to the output gap using the sum of consumption and investment (private and public)
Source: IMF staff calculations

14. An analysis of the cross-sectional distribution of inflation components indicates that the acceleration in price dynamics might be due to concentrated sectoral shocks, but also to other factors. Sector-specific shocks tend to increase the variability of relative prices in the presence of nominal rigidities. Given the cost of price adjustment, only a small share of sectors facing large idiosyncratic shocks adjust their prices in any given period, resulting in higher relative price variability when shocks materialize (Ball and Mankiw 1995). Consequently, an increase in relative price variability—reflected in an increase in the degree of asymmetry of relative price distribution—tends to be associated with an increase in the overall price level and higher inflation (Ratfai 2004). Conceptually, sector-specific shocks and the associated shift in the degree of asymmetry in the distribution of relative prices can stem either from shifts in sectoral costs or in sector-specific demand. However, there is empirical evidence in the literature that an increase in the degree of asymmetry of relative price distribution tends to be associated with idiosyncratic supply shocks (Ball and Mankiw 1995, Suvanto and Hukkinen 2004). Building on these considerations a

[5] An inquiry by a Parliamentary Commission in early-2022 suggested, for example, that disruptions in the supply of cooking oil was linked to insufficient imports and domestic production. There are also concerns about speculation and smuggling to neighboring countries. More recently, the authorities have announced a renewed crackdown on speculation amid continuing disruptions in the supply of some staples.

graphical analysis of the distribution of relative prices in Algeria, proxied by the distribution of changes in 22 components of the CPI, highlights the following (figures 5.a and 5.b):

- ***The asymmetry of relative price distribution increased in 2022.*** This could indicate an important role for concentrated, sector-specific shocks, likely on the supply side, in driving the acceleration in inflation.

- ***The rise in average inflation has outpaced the increase in the asymmetry of relative price distribution.*** There is a statically significant correlation between average inflation and the skewness of relative price distribution. However, it is noteworthy that in 2021 and 2022, average inflation outpaced the increase in the skewness of the distribution of its components. This points to broader price pressures beyond idiosyncratic sectoral shocks and likely contribution of non-supply factors to the acceleration in inflation.

Figure 5a. Distribution of Inflation Components*

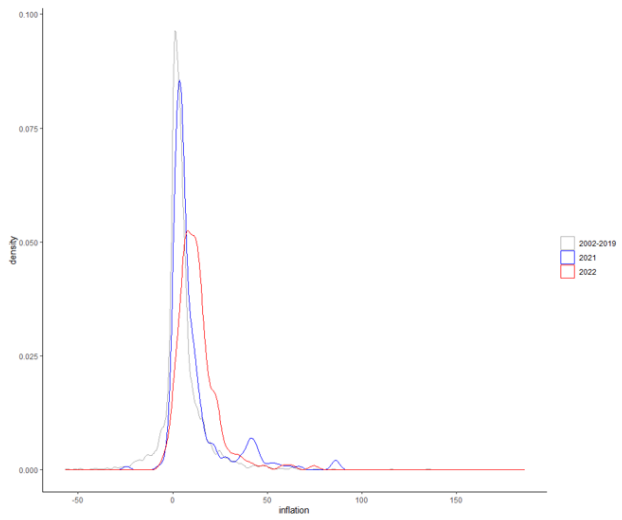
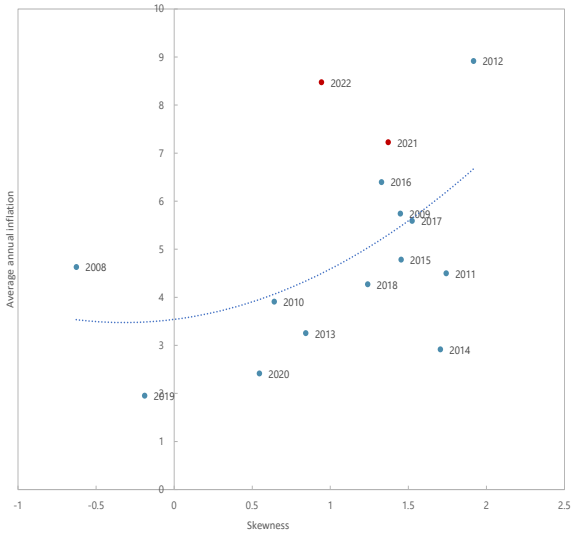


Figure 5b. Skewness of Inflation Distribution and Average Inflation*



**The lefthand chart depicts the distribution of the annual change in 22 CPI components. The righthand chart depicts the correlation between the skewness (degree of asymmetry) of the distribution and the average inflation level in each year.*

Source: IMF staff calculations.

15. A univariate decomposition of the inflation process highlights a broad acceleration in inflation prior to the current shock and risk of persistence of current price pressures. We follow the approach presented in Koranchelian (2003) which decomposes Algeria's inflation process into three unobserved components: (i) a trend reflecting "underlying inflation" influenced by policy shifts; (ii) a seasonal component, which is largely influenced by holidays or the agricultural cycle and its implications for food prices; and (iii) an irregular component reflecting exogenous shocks. We use

an ARIMA-based model to update the analysis and find similar results for the period considered in that paper (i.e.1996-2003). For more recent years, we note the following (Figure 6):

- ***Trend inflation has been rising since 2019.*** Trend inflation bottomed out in 2019 and its acceleration gathered momentum in the second half of 2020. It appeared to be stabilizing at high levels in mid-2022. Trend monthly inflation has been around 0.63 percent over the last year, which would translate into a high annual inflation of around 7.8 percent. The rise in trend inflation well above its peaks during the previous episodes of high inflation in 2012 and 2017 points to broad-based price pressures and risk of persistence of elevated inflation amid a loose monetary policy stance and projected easing in fiscal policy.

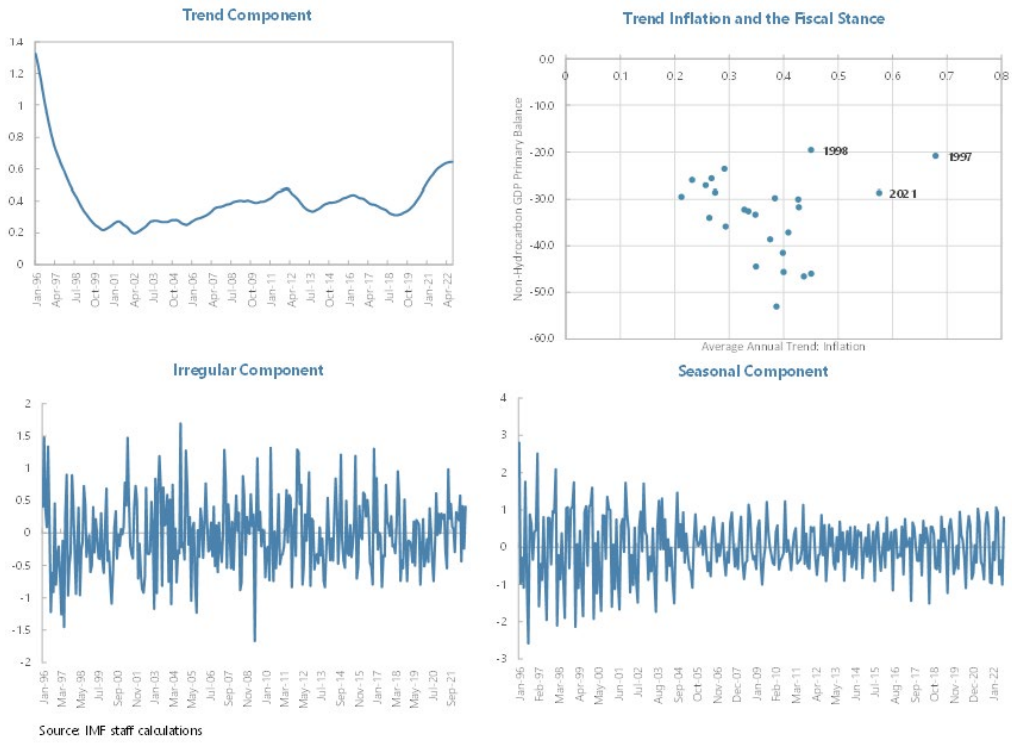
- ***Trend inflation is correlated with shifts in the fiscal policy stance***, as shown in Figure 6.[6] It is noteworthy that 2021 is an outlier for the historical correlation between inflation and the fiscal deficit (alongside 1997 and 1998): inflation in that year was much higher than the level that could be expected based on its historical correlation with the fiscal deficit. One possible reason is a larger-than-usual role of supply factors in igniting price pressures in addition to policy-driven demand.

- ***The irregular component points to deflationary pressures in 2019-2020 which have recently dissipated.*** These deflationary pressures were concomitant with the "*Hirak*" unrest in 2019 and a number of exogenous developments in 2020 such as the collapse in international commodity prices and abundant domestic harvests on the supply side, and the pandemic-related hit to income which weighed on demand. These downward pressures appear to have subsided once the economy emerged from the first stages of the pandemic, in late 2020. More generally, the irregular component has been sizeable over the years and points to a build-up of price pressures around some developments such as the public sector salary increase in 2012 and the VAT hike in 2017. Public sector wages and pensions were increased in 2022 and an additional adjustment has been announced for 2023, which could aggravate price pressures.

16. In summary, our descriptive and univariate analysis provides preliminary insights into recent inflation trends in Algeria which have been mostly driven by domestic factors. A broad-based pick-up in trend inflation started in late 2019 and accelerated in 2021 and 2022 among a concomitance of global and domestic shocks, both on the demand and supply side. While global factors have likely played a role in driving the rise in inflation, the contribution of domestic forces appears to be larger. There are indications that cost-push factors have played a significant role in fueling inflation, but other shocks, possibly demand-pull forces, are also at play. The acceleration in trend inflation points to significant risks of persistence, particularly amidst indications that the output gap has closed, sizeable fiscal easing and announced wage increases.

[6] Correlation with the growth in M2 growth—which would reflect changes in the monetary policy stance—is weak and statistically insignificant (not shown).

Figure 6. A Decomposition of Monthly Inflation into Three Unobserved Components



Source: IMF staff calculations

C. Drivers of Inflation: Demand and Supply Factors

Selective Review of the Literature

17. The analysis in this paper adds to a rich literature studying to analyze the role of demand and supply factors, both domestic and external, in inflation dynamics. The Phillips curve is the workhorse framework in empirical analyses. Early versions of the Phillips curve focused on the inflation-unemployment trade-off, but subsequent extensions to the framework over time have allowed an examination of the role of additional variable. The triangular Phillips Curve (Gordon, 2011) capture three sets of determinants: (i) inertia; (ii) domestic demand; and (iii) cost-push factors. This framework has been used, for example, by Lanau, Robles and Toscani (2018) to analyze the dynamics of inflation in Colombia. Another recent study (IMF 2022), based on an augmented triangular Phillips curve (i.e. including also forward-looking inflation expectations), examines the role of external and domestic factors in inflation in the Middle East and Central Asia and finds that external factors have been the main driver of price dynamics for the region—both historically and in the current episode of inflation. The analysis also suggests that pass-through of international food prices is estimated to have the strongest impact on domestic inflation dynamics in most countries, while that of supply-chain disruptions appears to affect domestic inflation with the longest lag. By contrast, international oil prices have had a smaller impact, given the prevalence of energy-related subsidies. Another result is that inflation expectations have also historically been an important driver

of inflation while domestic factors do not appear to have a statistically significant effect on inflation, in part because of measurement errors. However, in the current episode, domestic factors have played a role in driving inflation dynamics in some countries, including expansionary fiscal and monetary policies and the strength of the ongoing recovery.

18. Several studies focus on understanding the inflationary process in Algeria, finding that money supply is an important determinant. Ben Naceur (2013) estimates a Vector Error Correction Model (VECM) to analyzes the short- and long-run determinants of inflation in Algeria between 2002 and 2011. He finds that over this period, the non-oil GDP output gap was the only determinant of headline inflation in the short run, while money supply and real GDP growth are the most important determinants in the long run. Souissi (2017) also uses a VECM to analyze the determinants of quarterly core inflation over 2003–16. The results indicate that in the short run, inflation is highly persistent and tends to be driven more by money supply than other policy factors. In the long run, however, both domestic macroeconomic policies and external factors influence inflation. More recently, a study by the Bank of Algeria (2022) employs an Autoregressive Distributed Lag Model (ARDL) to examine the determinants of monthly inflation over the period 2011-21. The results suggest that money supply, unitary import prices and the nominal effective exchange rate are important determinants of long-run inflation, with the latter two factors accounting for 91 percent of predicted inflation over the period.

19. The analysis in this paper combines the insights from the various papers cited above to re-examine the drivers of inflation in Algeria. We follow Lanau, Robles and Toscani (2018) in adopting the triangular Phillips Curve as our conceptual framework and estimating this relationship for the various subcomponents of inflation. Section II provides details.

Empirical Strategy

20. We first examine a basic Phillips curve equation to analyze the relationship between inflation and demand factors in Algeria. Due to data limitations, the estimation equation does not augment the Phillips curve with an explicit (forward-looking) inflation expectations term as explanatory variable. Nevertheless, lagged inflation (inertia) can capture to some extent any backward-looking component to inflation expectations. Queyranne, Lafarguette and Johnson (2022) in fact show that the IMF's 5-year ahead projections as measure of forward-looking inflation expectations for Algeria cannot explain the distribution of future core inflation. By contrast, lagged core inflation has a significant predictive power for future core inflation, especially when inflation is high.

Our model specification is as follows:

$$\pi_t = c + \alpha(L)\pi_{t-1} + \beta(L)(y_t - y_t^*) + u_t \qquad \textit{(model 1)}$$

In this specification:

- π_t is a measure of year-on-year inflation[7],
- (y$-y_t^*$) is a measure of slack in the economy at time t and captures demand pressures,
- α(L), β(L) and δ(L) are lagged polynomials, and
- u_t is a vector of shocks.

21. We then specify a triangular Phillips curve to examine the effect of demand and supply factors on inflation in Algeria. For this purpose, we add a vector of supply-side variables, s_t, to model 1. Our model specification is as follows:

$$\pi_t = c + \alpha(L)\pi_{t-1} + \beta(L)(y_t - y_t^*) + \gamma(L)s_t + u_t \qquad (model\ 2)$$

22. Empirically, we estimate the model as an autoregressive distributed lag ARDL(p,q) process as follows:

$$\pi_t = c + \sum_{i=1}^{p} \alpha_i \pi_{t-i} + \sum_{k=1}^{m}\sum_{j=0}^{q} \beta_{k,j} X_{k,t-j} + \epsilon_t$$

In this specification:

- $X_{k,t-j}$ is the vector of regressors including the output gap (y$-y_t^*$) and other supply-side variables chosen based on the dependent variable (headline, core, non-food and non-regulated non-food inflation)
- and ϵ_t a white noise process.

23. The estimation of an ARDL allows for estimation with variables which have different orders of integration. It avoids the constraints on the interpretation of common cointegration tests due to data limitations and structural breaks. ARDL processes also allow a degree of flexibility in modelling by permitting differences in the lag length across variables— with optimal lag length determined based on an analysis of common information criteria—and have good small sample performance.

[7] We estimate the equation for headline, core, non-food, and non-regulated non-food products inflation.

Data

24. The data for the empirical analysis are at quarterly frequency and are available for most variables for the period 2002Q1 to 2022Q2. The main variables are measured as follows:

- *Inflation:* is at quarterly frequency measured using the quarter-on-quarter change in the CPI. We first use alternative measures of inflation based on headline, core (i.e. excluding fresh food and regulated prices), non-food and non-regulated non-food products price indices. We focus the analysis on measures of non-food inflation which are less volatile and more strongly related to demand pressures.

- *Demand pressures:* are captured using measures of slack estimated using univariate filters (Hodrick-Prescott, HP, and Christiano-Fitzgerald, CF). Our preferred measure, in line with the analysis in IMF(2022) is the output gap for non-hydrocarbon GDP (NHGDP). However, given data limitations, we also use alternative measures including the output gap for total GDP and a domestic demand gap, which is computed analogously to the output gap using the sum of consumption and investment (private and public) to proxy for domestic demand.

- *Cost-push factors:* are proxied using various indicators. External supply pressures are captured using commodity import prices adjusted for changes in the nominal effective exchange rate as a proxy for import prices in dinar, global supply chain tensions as measured by the New York Federal Reserve's (NY Fed) Global Supply Chain Pressure Index. Data on rainfall from the World Bank is considered as proxy for weather shocks and lagged values of the producer price index are considered as proxy for domestic supply pressures. In addition, following Mankiw and Ball (1995), we include an index of Relative Price Variability (RPV) index as a proxy for supply shocks in the presence of significant domestic nominal rigidities. For a given period t (quarter), the index is defined as: $RPV = [\sum_{i=1}^{m} w_i \ (\pi_i - \overline{\pi})]^{(\frac{1}{2})}$ where w_i is the weight of the i-th component in the CPI, π_i is the inflation of the i-th component and $\overline{\pi}$ is total CPI inflation during the period.

- *Dummy variables* to control for policy shocks such as the VAT hike in 2017 or exogenous shocks such as the '*Hirak*' protests of 2019.

Summary statistics and the results of unit root tests are presented in Appendix tables A1 and A2.

Results

25. The estimation results suggest that cost-push factors have played a significant role in fueling inflation but that demand-pull forces are also at play. We first estimate the equations for the basic Phillips curve equation (model 1) using alternative measures of inflation and the output gap. We find some statistically significant results for measures of nonfood inflation. We then extend the analysis to a triangular Phillips curve (model 2) by adding supply side variables to the five Phillips curve specifications yielding statistically significant results for the relationship between inflation and the output gap. The results are presented in Tables 1 and 2 and are broadly in line with

those in previous studies for a broader sample of countries in the Middle East and Central Asia.[8] They can be summarized as follows:

- *Domestic demand has likely contributed to nonfood inflation.* Under the basic Phillips curve model, i.e model 1, there is a positive association between measures of non-food inflation and the output gap based on five of the 12 tested specifications. These results should still be interpreted with caution due to data limitations and difficulties in computing the output gap reliably using statistical filters. The existence of a relatively large informal sector in Algeria could be another factor affecting the statistical relationship between inflation and the output gap.

- *Supply shocks, both domestic and external, seem to be important drivers of inflation in Algeria*. External supply pressures, as measured by the NY Fed Global Supply Chain Index, and import prices are also statistically significant for non-food non-regulated inflation. Rainfall, lagged measures of the PPI and the RPV did not yield statically significant results.

- *There is a lot of inertia in non-food inflation, which suggests that inflation becomes harder to eradicate once it reaches high levels*. Although the econometric specification does not explicitly identify the role of expectations, significant inertia is consistent with the idea that people start making price decisions based on past inflation dynamics, contributing to self-fulfilling acceleration in prices.

26. Taken together, these results suggest that policy should be tightened to help reduce current inflationary pressures. The easing of external supply pressures and commodity prices, the appreciation of the dinar in the latter part of 2022 as well as base effects following sharp increases in the prices of a narrow range of food prices in late 2021 might have contributed to the slight deceleration in inflation between September and November 2022. However, significant inertia and broad price pressures suggest the supply shocks may have a persistent effect on the price level and it may be more difficult to reduce inflation once it reaches high levels. The continuation of an accommodative monetary policy stance and announced sizeable fiscal easing and wage increases at a time when the output gap appears to have closed could exacerbate price pressures. This calls for immediate monetary policy tightening to protect price stability alongside gradual fiscal policy tightening to avoid exacerbating price pressures.

[8] We focus the results on non-food and non-food non-regulated inflation which are the measures of inflation which tend to be more significantly associated with the output gap.

Table 1. Algeria: ADRL Regression Results for a Basic Phillips Curve Specification

	Non-food inflation		Non-food non-regulated inflation		
	NHGDP output gap (Filter CF)	*Domestic demand gap (filter HP)*	*GDP output gap (filter HP)*	*GDP output gap (filter CF)*	*Domestic demand gap (filter HP)*
L.inflation[1]	1.067***	1.068***	0.526***	0.623***	0.606***
	(0.112)	(0.111)	(0.116)	(0.090)	(0.089)
L2.inflation	-0.242**	-0.271**	0.026		
	(0.112)	(0.110)	(0.131)		
L3.inflation			0.187		
			(0.113)		
Output gap	0.175*	0.029*	0.069*	0.17*	0.065*
	(0.045)	(0.017)	(0.039)	(0.102)	(0.073)
L.Output gap	-0.323**		-0.062	-0.178*	
	(0.16)		(0.041)	(0.100)	
L2.Output gap	0.183*		-0.074*		
	(0.09)		(0.040)		
C	0.189***	0.219***	0.302**	0.418***	0.442***
	(0.07)	(0.07)	(0.125)	(0.114)	
Observations	78	78	77	79	79
R-squared	0.769	0.765	0.49	0.435	0.435
Adjusted R-squared	0.753	0.755	0.45	0.412	0.420
Log likelihood	0.792	0.009	-54.74	-59.627	-59.610
Residual sum of squares	4.475	4.566	18.69	20.928	20.920
F-statistic	48.049	80.180	11.31	19.212	29.231
Number of models evaluated	12	12	12	12	12

Notes:
1. Lagged values of the measure of inflation used on the lefthand side of the equation specification.
The Akaike Information Criteria is used to select the optimal lags.
Source: IMF staff.

Table 2. Algeria: ADRL Regression Results for a Triangular Phillips Curve Specification

	Non-food inflation		Non-food non-regulated inflation		
	NHGDP output gap (Filter CF)	*Domestic demand gap (filter HP)*	*GDP output gap (filter HP)*	*GDP output gap (filter CF)*	*Domestic demand gap (filter HP)*
L.inflation[1]	1.052***	1.031***	0.523***	0.637***	0.613***
	(0.113)	(0.111)	(0.115)	(0.088)	(0.084)
L2.inflation	-0.218*	-0.223**	0.037		
	(0.115)	(0.112)	(0.127)		
L3.inflation			0.212*		
			(0.113)		
Output gap	0.020	0.034*	0.069*	0.033	0.075**
	(0.027)	(0.017)	(0.039)	(0.053)	(0.034)
L.Output gap			-0.043		
			(0.041)		
L2.Output gap			-0.058		
			(0.041)		
Δ Supply chain index	0.071	0.091	0.218	0.243**	0.284**
	(0.060)	(0.059)	(0.132)	(0.121)	(0.118)
L.Δ Supply chain index	0.081	0.081		0.267**	0.263**
	(0.061)	(0.059)		(0.123)	(0.118)
Adjusted Import price index [2]	-0.002	-0.003	-0.026	-0.027	-0.026
	(0.009)	(0.009)	(0.018)	(0.018)	(0.017)
L.Adjusted Import price index	0.016*	0.013	0.029	0.035**	0.032*
	(0.009)	(0.009)	(0.022)	(0.018)	(0.017)
L2.Adjusted Import price index			-0.006		
			(0.023)		
L3.Adjusted Import price index			0.042*		
			(0.022)		
L4.Adjusted Import price index			-0.046**		
			(0.018)		
C	0.150**	0.182**	0.256**	0.366***	0.394***
	(0.071)	(0.070)	(0.128)	(0.116)	(0.113)
Observations	78	78	77	79	79
R-squared	0.78	0.79	0.58	0.51	0.54
Adjusted R-squared	0.76	0.77	0.50	0.47	0.50
Log likelihood	2.97	4.73	-47.24	-54.05	-51.70
Residual sum of squares	4.23	4.05	15.38	18.17	17.12
F-statistic	35.85	37.97	7.43	12.44	13.94
Number of models evaluated	500	500	500	500	500

Notes:
1. Lagged values of the measure of inflation used on the lefthand side of the equation specification.
2. Adjusted for the change in the nominal effective exchange rate
The Akaike Information Criteria is used to select the optimal lags.
Source: IMF staff.

D. Conclusion and Policy Implications

27. The Bank of Algeria, like many other central banks, is grappling with the complex question of the effectiveness of monetary policy tightening when inflation appears to be at least partly driven by supply shocks. Results from an investigation of the drivers of inflation in Algeria suggest that global supply shocks, such as supply chain disruptions during the pandemic followed by the war in Ukraine, are important determinants of non-food inflation in Algeria. However domestic factors have played a more important role in driving the upsurge in inflation. These domestic factors relate to both supply shocks, such as a recent drought and reported disruptions to domestic supply of some basic goods, and demand, with the continuation of an accommodative monetary policy stance amid indications of closure of the output gap.

28. Concerns that post-pandemic price pressures could be more persistent than in the recent past are prompting a rethink of the role of monetary policy. More precisely, the robustness of policy strategies to "run the economy hot" and "look through" temporary supply shocks" have been called into question in a context where risks to inflation are on the upside (Gopinath, 2022). Of note, the current supply shocks have occurred in the context of an accommodative monetary policy stance to support economic recovery. A multitude of factors (the pandemic, war and climate change) may also usher in a new inflationary era in which supply shocks are larger and more frequent, and in which inflation expectations may be less well-anchored. Moreover**,** the recent episode of inflation in Algeria has been characterized by price adjustments by producers despite the absence of changes in regulated prices, possibly suggesting anticipations of higher inflation, attempts to avoid a compression in margins or disruptions to domestic supply. Thus, supply shocks can spillover and become persistent, especially in the light of significant inertia. Thus, fiscal and monetary policy tightening are indeed appropriate to rein in inflationary pressures and prevent a de-anchoring of inflation expectations, although their pace will need to be calibrated to domestic economic conditions. Early action on the monetary policy can help contain spillovers and avert more abrupt future adjustments.

Appendix I. Statistical Appendix

Table A1. Algeria: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Headline inflation	82	1.1	1.0	-1.5	4.1
Core inflation	81	1.1	0.8	-2.2	2.6
Nonfood inflation	82	1.0	0.5	0.1	2.6
Nonfresh food inflation	82	1.0	0.6	-0.3	2.9
Nonregulated nonfood products inflation	81	1.2	1.3	-2.9	5.3
Nonregulated products inflation	81	1.1	0.7	-0.4	2.4
Food inflation	82	1.2	2.1	-4.8	6.7
Regulated products inflation	81	0.7	1.3	-4.1	6.0
Fresh food inflation	84	1.4	4.2	-11.5	14.4
Relative price variability index	83	2.5	0.7	1.3	4.6
Nominal effective exchange rate (NEER) index	86	-0.6	2.5	-5.5	7.2
NY Fed supply chain index	87	0.1	1.0	-1.2	4.2
Commodity import price index	84	1.1	4.0	-8.9	9.9
Rainfall index	80	0.3	9.4	-17.5	37.8
PPI	82	0.8	0.8	-0.9	3.1
Output gaps (percent)					
Industrial production (HP filter)	88	0.0	2.5	-13.3	5.3
Industrial production (CF filter)	88	0.0	1.8	-7.0	5.2
Manufacturing (HP filter)	88	0.0	3.6	-17.2	8.4
Manufacturing (CF filter)	88	-0.1	2.3	-8.8	8.0
Nonhydrocarbon GDP (HP filter)	89	-0.1	1.7	-10.2	2.9
Nonhydrocarbon GDP (CF filter)	89	0.0	1.2	-3.4	3.0
GDP (HP filter)	89	-0.1	1.7	-9.5	2.8
GDP (CF filter)	89	0.0	1.1	-4.4	2.5
Demand gap (HP filter)	89	-0.1	1.6	-9.5	2.7
Demand gap (CF filter)	89	0.0	1.4	-4.7	2.9

Source: Algerian and Authors' calculations.
Notes:
Data for most variables cover the period 2002Q1 to 2022Q3
The growth rates of the variables are calculated where appropriate, using the quarter-on-quarter change.

Table A2. Algeria: Unit Root Tests

Variable	ADF test	Phillips-Perron test		KPSS Test
	Z-statistic(1)	Z(rho)	Z(r)	Test statistic at lag 3
Headline inflation	-5.073***	-66.655***	-7.387***	0.0604
Core inflation	-4.258***	-42.297***	-5.247***	0.0429
Nonfood inflation	-3.105**	-15.531*	-2.852*	0.07
Nonfresh food inflation	-4.641***	-38.575***	-5.063***	0.0409
Nonregulated nonfood products inflation	-5.217***	-85.669***	-8.725***	0.0628
Nonregulated products inflation	-3.431***	-27.46***	-4.097***	0.0655
Food inflation	-5.698***	-92.702***	-9.792***	0.0895
Regulated products inflation	-6.101***	-70.371***	-8.06***	0.0392
Fresh food inflation	-7.037***	-94.76***	-10.886***	0.0578
Relative price variability index	-6.464***	-91.208***	-9.689***	0.12
Nominal effective exchange rate (NEER) index	-6.397***	-53.874***	-6.192***	0.0384
NY Fed supply chain index	-2.226	-10.213	-2.273	0.275
Commodity import price index	-4.944***	-25.908***	-3.736***	0.128
Rainfall index	-5.744***	-87.698***	-9.307***	0.0305
PPI	-5.128***	-66.03***	-7.065***	
Output gaps (percent)				
Industrial production (HP filter)	-5.828***	-64.419***	-7.132***	0.0312
Industrial production (CF filter)	-13.048***	-32.328***	-4.125***	0.0215
Manufacturing (HP filter)	-6.529***	-64.945***	-7.451***	0.0404
Manufacturing (CF filter)	-11.337***	-31.779***	-4.015***	0.0298
Nonhydrocarbon GDP (HP filter)	-5.489***	-60.929***	-6.845***	0.0559
Nonhydrocarbon GDP (CF filter)	-8.81***	-24.637***	-3.533***	0.0395
GDP (HP filter)	-4.493***	-49.275***	-5.779***	0.0667
GDP (CF filter)	-9.211***	-25.298***	-3.601***	0.0414
Demand gap (HP filter)	-4.558***	-43.236***	-5.225***	0.0485
Demand gap (CF filter)	-9.08***	-23.801***	-3.487***	0.0401

*,**,*** indicate rejection of the null hypothesis at the 10%, 5% and 1% level of significance.
The null hypothesis under the ADF and Phillips-Perron test is that the series has a unit root.
The null hypothesis under the KPSS test is that the series is stationary. The critical values for the KPSS test are as follows:
10%:0.119 5%:0.146 2.5%: 0.176 1%: 0.216
Source: Authors' calculations.

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