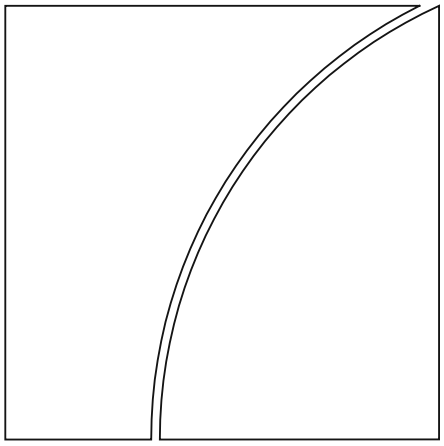

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Monetary policy decision-making and communication under high uncertainty

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Foreword

Periods of heightened uncertainty have become a defining feature of the global economic landscape, challenging central banks in unprecedented ways. The shocks of recent years – from the Covid-19 pandemic and persistent inflation to volatile financial conditions and geopolitical tensions – have tested the resilience of monetary policy frameworks and the agility of policy responses worldwide. Against this backdrop, central banks have reassessed their analytical tools, decision-making processes and communication strategies to ensure the continued effectiveness and credibility of monetary policy.

This volume offers a unique window into the experiences of central banks across the Americas and beyond, providing a comprehensive view of how institutions have navigated uncertainty in recent times. Drawing on both survey-based evidence and in-depth case studies from individual central banks, the chapters explore the evolving role of scenario analysis, the integration of high-frequency data and expert judgment, and the increasing importance of transparent and adaptive communication. Real-world experiences from 10 countries illustrate the diversity of challenges they face and the range of innovative responses they have developed.

One of the central themes emerging from these contributions is the need for a risk management approach to monetary policy. As the limits of models are exposed in times of heightened uncertainty, central banks are adopting more systematic scenario analysis, broadening their toolkit to include alternative models, and embracing intellectual humility in policy deliberations. At the same time, effective communication has become an indispensable policy instrument. Central banks are placing greater emphasis on clarity, transparency and accessibility, aiming to anchor expectations and maintain trust even when the outlook is clouded by uncertainty.

The chapters also highlight the value of institutional flexibility. Whether through adapting forward guidance, refining inflation forecasts or incorporating new data sources, central banks are demonstrating the importance of being able to respond rapidly as conditions evolve. The collective experience documented here underscores that uncertainty is not an exception but a constant in monetary policymaking. In response, central banks are learning to assess and communicate its implications with greater rigour and openness.

This volume stands as a testament to the power of collaboration and knowledge-sharing within the central banking community. It was brought to fruition by the efforts of the Consultative Group on Monetary Policy (CGMP) with support from the BIS Americas Office over the course of 2025 under the auspices of the Consultative Council for the Americas. It is intended as a resource for policymakers, researchers and practitioners seeking to understand and strengthen the foundations of monetary policy in an uncertain world. By sharing lessons learned and best practices, this volume will contribute to the ongoing development of resilient, credible and transparent policy frameworks that can meet the challenges of today and tomorrow.

Diogo Guillen
Deputy Governor, Central Bank of Brazil
Chair of the CGMP

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Chief Representative
BIS Americas Office

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Monetary policy decision-making and communication under high uncertainty

Insights from a survey of central banks in the Americas and beyond

Eduardo Amaral, Torsten Ehlers, Ilhyock Shim and Alexandre Tombini.[1]

Abstract

Extremely high levels of uncertainty pose challenges for monetary policy decision-making and communication by central banks. This chapter summarises the results of a survey among central banks in the Americas and some additional emerging market economies. The survey responses show that, even though uncertainty is not explicitly embedded in monetary policy reaction functions, it affects several important aspects of the decision-making process such as macroeconomic modelling and the choice of relevant scenarios. Uncertainty also plays a significant role in shaping central banks' communication strategies, including the use of a range of communication and visualisation tools as well as a more restricted use of forward guidance.

Keywords: uncertainty; monetary policy; monetary policy communication; monetary policy reaction function; forward guidance; high-frequency data; scenario analysis.

JEL classification: E44, E58, F42, G01.

[1] We thank Diogo Guillen, Daniel Rees, Frank Smets and the participants in the meeting of the Consultative Group on Monetary Policy in Mexico City on 2–3 October 2025 for comments, and Berenice Martinez for excellent research assistance. The views expressed in this article are those of the authors and do not necessarily reflect the views of the Bank for International Settlements or its member central banks.

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1. Introduction

Many indicators of economic uncertainty have reached levels last seen during the Great Financial Crisis (GFC) in 2008–09 or the Covid-19 pandemic. This poses challenges for monetary policy decision-making and communication by central banks. The high level of uncertainty gives rise to both a wider range of economic outcomes and a higher likelihood of rapid and profound changes in financial markets and the macroeconomy. At the same time, central banks have increased their focus on communication, expanded their range of tools and further developed their analytical capabilities during these recent crises.

The Consultative Group on Monetary Policy (CGMP), consisting of Bank for International Settlements (BIS) member central banks in the Americas and working under the auspices of the Consultative Council for the Americas (CCA), conducted a survey to explore how central banks navigate times of heightened uncertainty in economic analysis, monetary policy decision-making and external communication. This chapter summarises central banks' responses to the survey. It highlights key trends, challenges and practices among the participating central banks.

The survey responses show that heightened uncertainty plays an important role in shaping central banks' monetary policy decisions and communication. Even though uncertainty is not explicitly embedded in monetary policy reaction functions, it affects several important aspects of the decision-making process such as macroeconomic modelling and the choice of relevant scenarios. Central banks in the Americas have also adjusted their communication strategies, including a more restricted use of forward guidance.

The key findings from the survey responses can be summarised as follows:

- To identify periods of heightened uncertainty, financial market volatility is the most closely scrutinised indicator. High-frequency data are a particularly valuable resource for central banks during these periods, as they enable the formation of real-time insights. However, volatility, gaps in coverage, definitional inconsistencies and the need for advanced technological infrastructure and skilled personnel can complicate their integration into monetary policy decision-making processes.
- The key sources of uncertainty and major shocks considered by central banks in 2025 include tariff/trade-related shocks and exchange rates, followed by oil prices, inflation and geopolitical risks. Some central banks also look at fiscal shocks and other non-oil commodity shocks.
- Central banks face significant modelling challenges from uncertainty, particularly in modelling the relationship between the output gap and prices, wage-price dynamics and exchange rate pass-through. Scenario analysis is widely used to evaluate alternative economic trajectories, with some central banks providing probability distributions around forecasts. Other central banks are exploring advanced techniques like artificial intelligence (AI)/machine learning (ML) and neural networks to analyse high-frequency data. All central banks extensively incorporate expert judgment.
- Central banks hold divided views on the relevance of the central scenario during periods of extreme uncertainty. While some central banks prioritise alternative scenarios in response to large, realised shocks such as the Covid-19 pandemic,

others emphasise the central scenario as a critical anchor for economic agents that helps to ensure predictability. The differing approaches often depend on the source and nature of uncertainty and the tendency of monetary policy committees to focus more on scenarios with quantifiable likelihoods than unforeseen events.

- To navigate uncertainty, central banks often adopt a cautious approach, adjusting policy rates in small, incremental steps. This gradualism is justified to provide a degree of predictability to economic agents and to support financial stability, which are particularly important during highly uncertain times. In addition, most central banks have revised their monetary policy strategies to make them more robust to shocks and more adaptable.
- Forward guidance tends to be more effective in environments with low uncertainty, as it provides clearer and more reliable signals on future monetary policy actions. Some respondents suggest that its impact diminishes in periods of heightened uncertainty, leading to divergent approaches among central banks. Some central banks avoid using forward guidance altogether during such periods, while others continue to employ it but attach specific conditions to account for the highly uncertain environment.
- During periods of heightened uncertainty, most central banks adapt their communication strategies by revising the frequency of updates or the way they present projections and scenarios. These changes are often driven by economic news, real-time market observations and feedback collected through institutional communication channels.
- One significant challenge for central banks is effectively communicating economic forecasts under high uncertainty to different audiences. To address this challenge, some central banks rely on visualisation tools such as fan charts, scenario analyses, conditional forecasts and probability distributions. However, using complex tools to describe uncertainty often risks being misunderstood or lost in translation, making it difficult to convey the nuances of uncertainty in monetary policy.

The remainder of this chapter is organised as follows. The next section provides details about the survey, while sections 3–8 are organised around the six main topics covered in the survey. The final section concludes.

2. Survey structure and respondents

The survey captured six main topics, starting with general questions around external communication and closing with questions on specific technical modelling issues and scenario analysis:

1. Capturing and quantifying uncertainty in economic analysis by central banks
2. Incorporating uncertainty into models and tools
3. The role of scenario analysis
4. Uncertainty and the monetary policy reaction function
5. Forward guidance under uncertainty

6. Central bank communication with the public under uncertainty

The survey questions were both quantitative and qualitative in nature and are provided in Appendix A.

Central banks from 12 countries responded to the survey questions: the Central Bank of Argentina, Central Bank of Brazil, Bank of Canada, Central Bank of Chile, Central Bank of Colombia, Central Bank of Costa Rica, Bank of Mexico, Central Reserve Bank of Peru, South African Reserve Bank, Central Bank of the Republic of Türkiye, US Federal Reserve (Board of Governors of the Federal Reserve System and Federal Reserve Bank of New York) and Central Bank of Uruguay.

The survey questionnaire included a combination of multiple-choice and open-ended questions. It was distributed in June to August, and the 12 central banks submitted their responses by early September 2025. Due to the breadth and depth of the questions, not all central banks provided answers to every question. Nevertheless, the responses collected offer a comprehensive perspective on how central banks address uncertainty across various aspects of their operations. To enrich the discussion, this chapter also integrates key insights from the subsequent CGMP meeting held in October 2025.

Responses were aggregated by giving equal weight to all respondents. When we interpret aggregated responses to questions where central banks were asked to rank alternatives by degree of importance (eg from most important to not important), the ordering assumes that discrete degrees are equally spaced. In cases of a tie, higher degrees of importance were given priority in the ranking ordering. However, each surveyed central bank has its own view and strategy on how to handle uncertainty, which may not necessarily coincide with the aggregate results presented in this chapter and the lessons derived from them. Individual survey responses are confidential and individual central banks are named only if their responses are solely based on publicly available information.

The presentation of the results in this chapter follows an inward-to-outward approach in the sequence of the monetary policy decision-making process, beginning with the capture and quantification of uncertainty and progressing towards its communication.

3. Capturing and quantifying uncertainty in economic analysis

Central banks use a range of tools and techniques to measure and incorporate uncertainty into economic analysis. Economic projections are usually based on a central scenario, and there is divergence among central banks with respect to how uncertainty affects the importance of the central scenario. In addition, based on past data, large shocks reduce the accuracy of economic projections. Central banks in some cases build alternative scenarios with different shocks ("known unknowns") for internal purposes, which may also be used for communication. Discussions at board meetings also tend to focus more on "known unknowns" than on "unknown unknowns".

Central banks rely on a set of criteria to identify changes in the level of uncertainty. Financial market volatility is the most frequently used, perhaps as it is readily available and well understood. All central banks acknowledge the stochastic nature of uncertainty and try to quantify it. Macro-at-risk models are the most widely used, which shows that central banks are in search of objective probabilities that may account for extreme scenarios and, possibly, scenarios with asymmetric probabilities.

Regarding the relevance of the central scenario or the need to use alternative scenarios during periods of extreme uncertainty, central banks have divided views. Roughly half of the survey respondents rely more on alternative scenarios during extreme uncertainty. Several of these central banks mentioned the Covid-19 pandemic as an example of an episode in which the central scenario lost importance. The other half of central banks believe that the central scenario maintains its relevance or even becomes more important if rising uncertainty makes economic agents more reliant on guidance and forecasts made by the central bank. It should be noted that monetary policy committees tend to focus on scenarios with quantifiable likelihoods, either objective or subjective, rather than on highly unexpected events that are difficult to estimate and often overlooked by decision-makers.

The differing views seem to be related to the source of uncertainty. If it is due to a large, realised macroeconomic shock, past data may prove to be of limited value due to the presence of non-linear effects or possible structural breaks, in addition to questions over the persistence of a large macroeconomic shock. If a shock is expected but has not been clearly observed yet, scenarios may be useful for internal deliberations but less so for communicating with the public. In contrast, when extreme uncertainty is involved, the central scenario may become more scrutinised by the public and, therefore, more important as economic agents pay greater attention to it when making decisions. In this case, the central scenario serves as a critical anchor for economic agents who seek stability and predictability.

Among different types of uncertainty, known unknowns followed by statistical uncertainty have been the most frequently discussed types of uncertainty in recent years. Fundamental uncertainty, or unknown unknowns, has usually been rarely discussed. Some central banks indicated that climate-related issues, terms of trade or behavioural assumptions regarding inflation (eg expectations are forward-looking or backward-looking) had been frequently discussed by the monetary policy board. This exemplifies how the thematic nature of uncertainty varies from country to country.

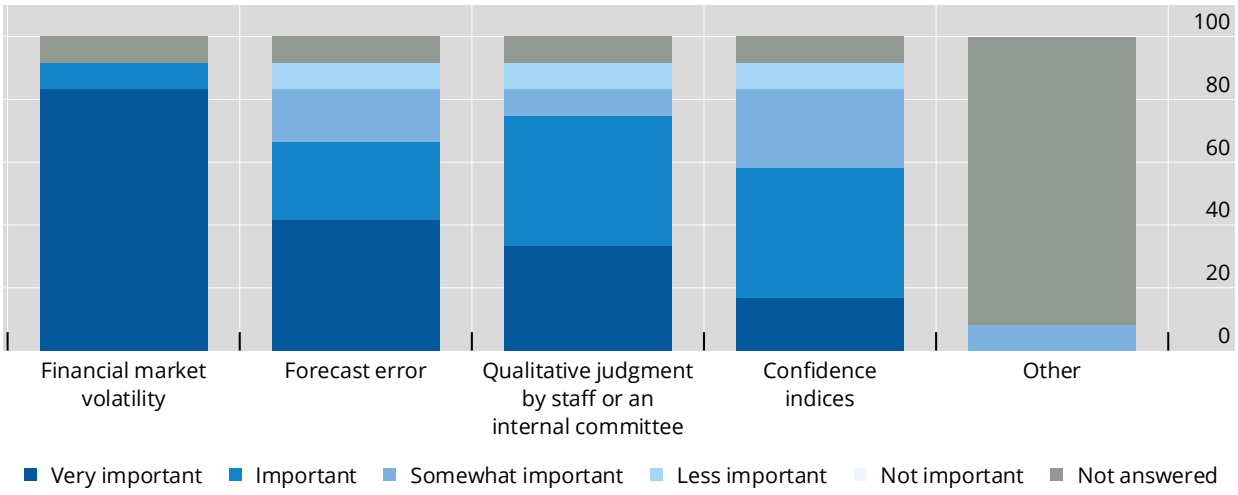
Among various types of indicators for measuring uncertainty, financial market volatility is the most important (Graph 1). The second and third most important types are forecast errors and qualitative judgment by staff or an internal committee. Close to these two is confidence indices (eg measures of consumer or producer confidence). One central bank pointed out that it relies on a wide range of economic and financial indicators as well as information from businesses and community contacts. Another central bank highlighted the importance of observing depositors' behaviour.[2] Moreover, some respondents noted that having different measures of uncertainty is advisable, as they are complementary and do not necessarily co-move.

[2] These responses align with the evidence presented in Bloom (2014) that the volatility of stock markets, bond markets and exchange rates, as well as that of GDP growth forecasts, rises steeply during recessions – periods in which uncertainty is also "fractal", meaning it increases whether viewed through macro or micro data. For a list of empirical measures of uncertainty, risk and volatility, as well as a discussion on their construction and relative advantages, see Cascaldi-Garcia et al (2023).

How important is each of the following criteria or indicators for your institution in identifying periods of heightened uncertainty?

As a percentage of respondents

Graph 1



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

Finally, among different types of tools to quantify uncertainty, the most used tool is macro-at-risk models. Fan charts, conditional probability distributions and scenario analysis were each mentioned by eight central banks. Next, there are confidence intervals, subjective probability distributions, objective probability distributions and conditional forecasts. One central bank noted that it uses predictive densities that include aspects of many of the alternative tools.

4. Incorporating uncertainty into models and tools

Central banks employ a variety of tools and models to incorporate uncertainty into their analyses. Central bank responses, however, also suggest that dealing with unprecedented or asymmetric risks as well as structural changes goes beyond mathematical models. Hence, several central banks highlighted the importance of expert judgment and historical analogy in their assessments. Most central bank staff have incorporated scenario-building as a tool for analysing uncertainty and presenting it to the board (Lane (2024); see also the next section). The survey responses also suggest that central banks sometimes expand their toolbox of underlying inflation measures in case of exceptional shocks. Currently, many central banks are exploring ways of incorporating AI/ML and neural networks into their economic analyses and forecasting process.

Many central banks emphasised the use of alternative scenarios, incorporating asymmetries, tail risks and non-linear effects to capture a broader range of potential outcomes beyond what standard models or historical data might suggest. In that sense, scenario analysis emerged as a common tool, with some central banks focusing on risks with meaningful macroeconomic implications even if under only subjective probabilities, often employing predictive density analysis to account for skewness and asymmetric shocks. Others noted the role of alternative models and simulations in constructing ranges for their outlooks, ensuring that the most relevant risks are

explicitly considered in their deliberations. Overall, qualitative evaluation and careful interpretation of economic models, acknowledging their limitations, were consistently underscored as key elements in navigating uncertainty.

Central banks employ a variety of tools and frameworks to address the challenge of distinguishing between structural and cyclical sources of uncertainty, as well as of determining whether shocks are supply-driven, demand-driven or a combination of both. Many institutions rely on a mix of several structural economic models, statistical methods and expert judgment. Common approaches include the use of time series models, such as vector autoregressions (VARs) with sign restrictions, Kalman filters and Bayesian VAR methods, to decompose shocks and assess their origins.

Several central banks highlighted the importance of structural assumptions and shock decomposition techniques, often integrating data on prices and real activity or conducting inflation decompositions by goods and services. These methods help to evaluate transmission channels and distinguish between supply and demand shocks.[3] Some institutions also mentioned sectoral indicators, stochastic volatility models and growth/inflation-at-risk frameworks to inform their assessments. While statistical methods and models are central to these exercises, many central banks noted the critical role of expert judgment and qualitative evaluation, particularly when real-time identification of structural breaks or policy changes are required.

Among the potential sources of uncertainty in modelling choices for the monetary policy transmission mechanism, most central banks pointed to the relationship between the output gap and prices. The second most cited sources were exchange rate pass-through and monetary policy power followed by the wage-price relationship. Other than these four sources, two central banks mentioned expectations formation, one central bank mentioned how firms set prices, one pointed to the degree of indexation in the economy and one central bank pointed to spillovers from the foreign sector to the domestic output gap and inflation.

Roughly half of central banks provide probability distributions when presenting forecasts to the board, with the other half presenting only point forecasts. One central bank clarified that the presentations are backed up by uncertainty qualifications as long as they are deemed relevant for the messages and the robustness of the forecasts.

Most central banks compute fan charts using objective probabilities recovered from econometric models. A few central banks calculate fan charts with subjective probabilities, ie based on expert judgment. Two central banks mentioned that they combine both objective and subjective probabilities. Of these two, one central bank said that it relies objectively on adjusted historical forecast errors and uses a two-piece normal distribution, while it calculates the probability of deviations in key forecast determinants by subjectively adjusting the variability assumed for each factor. These two strategies are then aggregated to estimate the overall skewness of inflation forecasts and compute the confidence bands accordingly.[4]

[3] For a list of transmission mechanisms of uncertainty and how they can be incorporated into structural models, see Fernández-Villaverde and Guerrón-Quintana (2020).

[4] The Central Bank of Colombia combines both types of probabilities to generate predictive density distributions. The methodology is explained in a box published in its July 2021 Monetary Policy Report. For details, see https://repositorio.banrep.gov.co/server/api/core/bitstreams/811e6b17-3874-4ba8-aa59-8476bed602e4/content.

Regarding the frequency of using scenario analysis, all central banks but two conduct scenario analysis on a regular basis. One central bank does it occasionally and the other does it rarely.

Central banks may want to adjust measures of underlying inflation to account for exceptional shocks that increase uncertainty (eg supply bottlenecks, energy price surges due to geopolitical conflicts). Three central banks responded that when they faced exceptional shocks, they adjusted underlying inflation measures to account for them. Another three said that they did not adjust, and yet three other central banks answered that they did in some cases. One central bank said that it monitors several indicators of underlying inflation which account for exceptional shocks in different ways. During the Covid-19 pandemic period, it built a dedicated supply bottleneck indicator to control for that factor. Another central bank mentioned that in the same period, it produced measures of core inflation that excluded the effects of some relief measures that had affected prices. One central bank mentioned that it complements traditional measures of inflation with indicators that focus on certain sectors or types of goods to provide more insights. Finally, one central bank stated that its preferred measures of core inflation are statistical in nature – median and trimmed consumer price index (CPI) measures.

To detect turning points in the economy using high-frequency data, most central banks are currently exploring the use of AI/ML or neural networks. Two central banks have already integrated them into their monitoring frameworks, while two do not rely on these types of tools. Most central banks perceive AI/ML and neural networks as possibly enhancing nowcasting of the business cycle and inflation forecasting. However, they pointed out that there are challenges in how to interpret these classes of models.

All central banks evaluate the uncertainty of both assumptions and modelling. In doing so, central banks rely on expert judgment to complement model-based outputs, especially during uncertain periods. Judgment is usually implemented through conditioning variables and sensitivity analysis, either as proposed by staff or at the request of the board. But judgment can also be made on modelling shocks to specific variables and designing risk scenarios that may be the focus of uncertainty at some point. Additionally, judgment applies to picking the most adequate model for a specific type of analysis. One central bank pointed out that during periods of elevated uncertainty, judgment-driven adjustments played a more prominent role.

Some situations in which expert judgment is expected to support analysis are when interpreting model limitations, adjusting for data anomalies and incorporating relevant information not captured by models. Central banks highlighted the limitations of traditional models in capturing uncertainty, particularly in the post-pandemic era. The need to address non-linearities, integrate alternative scenarios and communicate baseline forecasts effectively was emphasised in their responses.

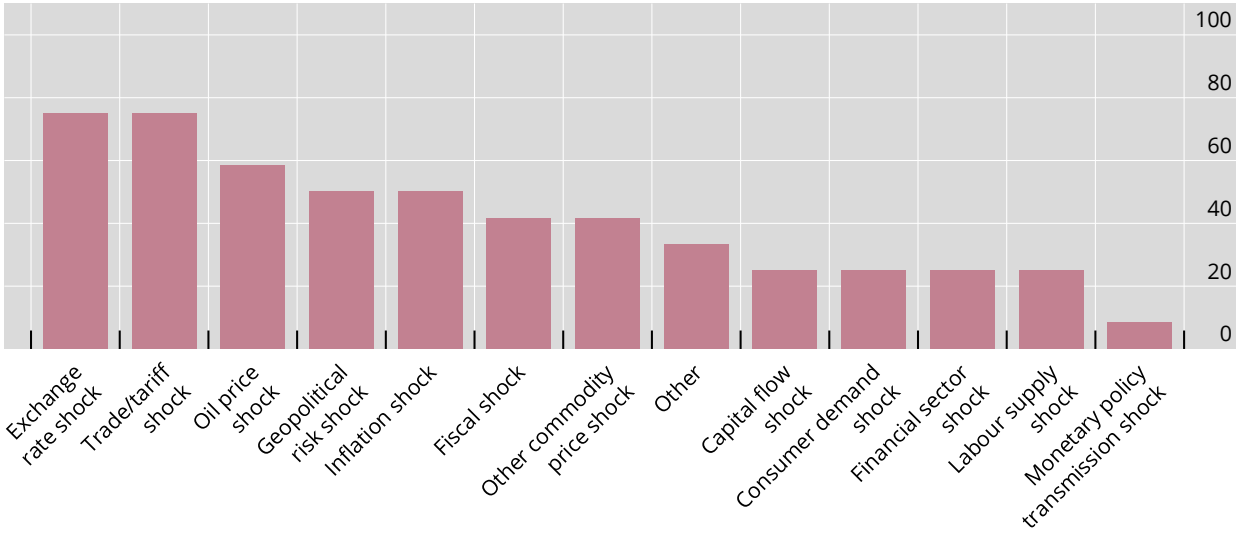
5. The role of scenario analysis

Scenario analysis is a critical tool for central banks, enabling them to explore a range of potential outcomes and prioritise scenarios based on their severity and macroeconomic impact (Hunter (2024)). Key sources of uncertainty include exchange rates, oil prices and geopolitical events.

Among the most cited scenarios currently being analysed are those involving exchange rate shocks and tariff/trade shocks (Graph 2). Next comes oil price shocks, followed by a tie between inflation shocks and geopolitical risk shocks. Then we have a tie between fiscal shocks and other non-oil commodity shocks. Some central banks also mentioned shocks related to capital flows, the financial sector, consumer demand and labour supply. One central bank mentioned monetary policy transmission shocks, and another mentioned the availability of natural resources.[5]

Types of scenarios currently considered by central banks

As a percentage of respondents — Graph 2



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

Central banks prioritise different scenarios, first based on the preferences of the board and the macroeconomic impact, and second based on the likelihood of the shock or its potential severity. In addition, central banks put less emphasis on the scenarios raised by market agents or the media than on the more tailored scenarios prepared by the central banks themselves.

The survey also contained questions about the sources of current uncertainty for constructing scenarios (eg levels of variables and their elasticities to shocks). Among nine potential sources, the most important one is inflation, followed by exchange rates. Next important are trade/tariffs and the output gap (Graph 3). Then come oil prices, geopolitical events, other commodities excluding oil, and the neutral rate. Migration and remittances is the least important source of uncertainty, appearing to affect only a few central banks in the sample.

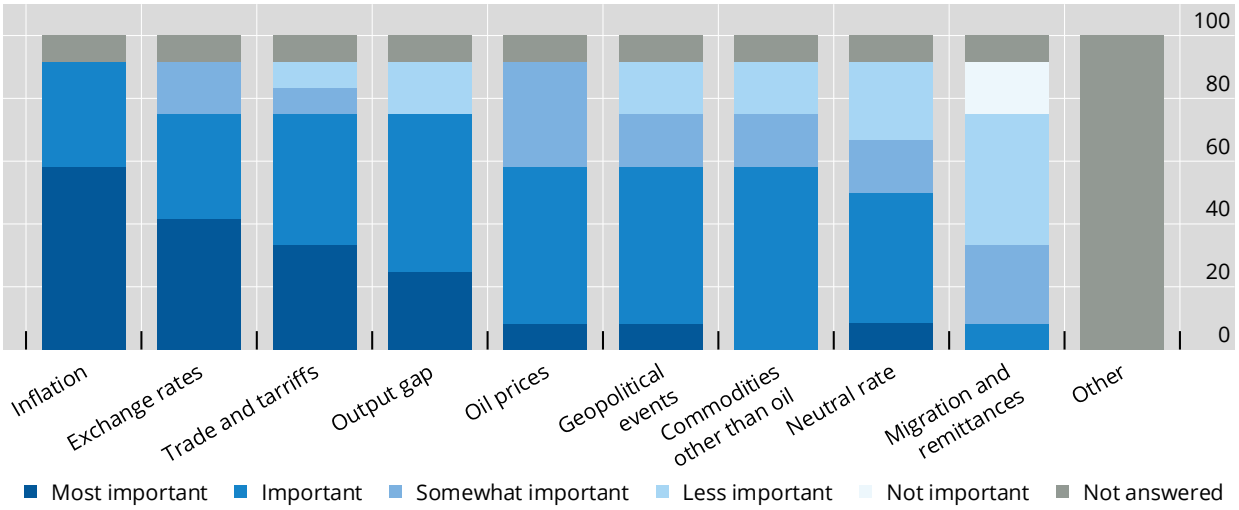
Finally, when using scenario analysis, most central banks use market-based assumptions (eg option-implied densities for commodity prices) to build scenarios.

[5] The Federal Reserve releases its quantitative scenarios used for monetary policy discussions to the public after five calendar years in the Federal Reserve's Tealbook.

Sources of current uncertainty for constructing different scenarios

As a percentage of respondents

Graph 3



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

6. Uncertainty and the monetary policy reaction function

This section explores how uncertainty influences monetary policy decisions, including the calibration of policy rates. The survey responses clearly show that uncertainty plays a significant role in shaping monetary policy decisions, even though it does not explicitly feature in the monetary policy reaction function. Instead, it affects decision-making processes indirectly, as central banks often adopt cautious approaches. Adjusting policy rates in small, incremental steps allows central banks to provide a degree of predictability and maintain financial stability during uncertain times. These cautious strategies are also a reaction to the uncertainty surrounding future events or the transmission of monetary policy itself. Furthermore, central banks adjust their strategies to enhance robustness against adverse outcomes, tailoring their approaches to the unique economic contexts, institutional frameworks and inflationary histories of their jurisdictions.

A closer look at the survey responses reveals that central banks adopt various approaches to address uncertainty in the transmission of monetary policy, balancing caution, agility and the lag in the effects of policy actions. A commonality across responses is the recognition of uncertainty as a critical factor in decision-making, with most institutions employing tools or strategies to manage it effectively. For instance, many central banks rely on scenario analysis, forecasting models and risk assessments to evaluate the strength and timing of transmission channels. These tools allow policymakers to simulate alternative scenarios, weigh responses based on likelihoods and adjust their strategies as new information becomes available.

Caution is another shared theme, with several institutions explicitly acknowledging the need for prudence in the face of uncertainty. Some central banks communicate pauses in policy adjustments to assess transmission effects, while others adopt a slower pace of action to maintain room for manoeuvre. One central

bank emphasised that uncertainty is considered when it directly affects the central bank's goals, balancing responsiveness to clear directional signals with caution when data are ambiguous or noisy.

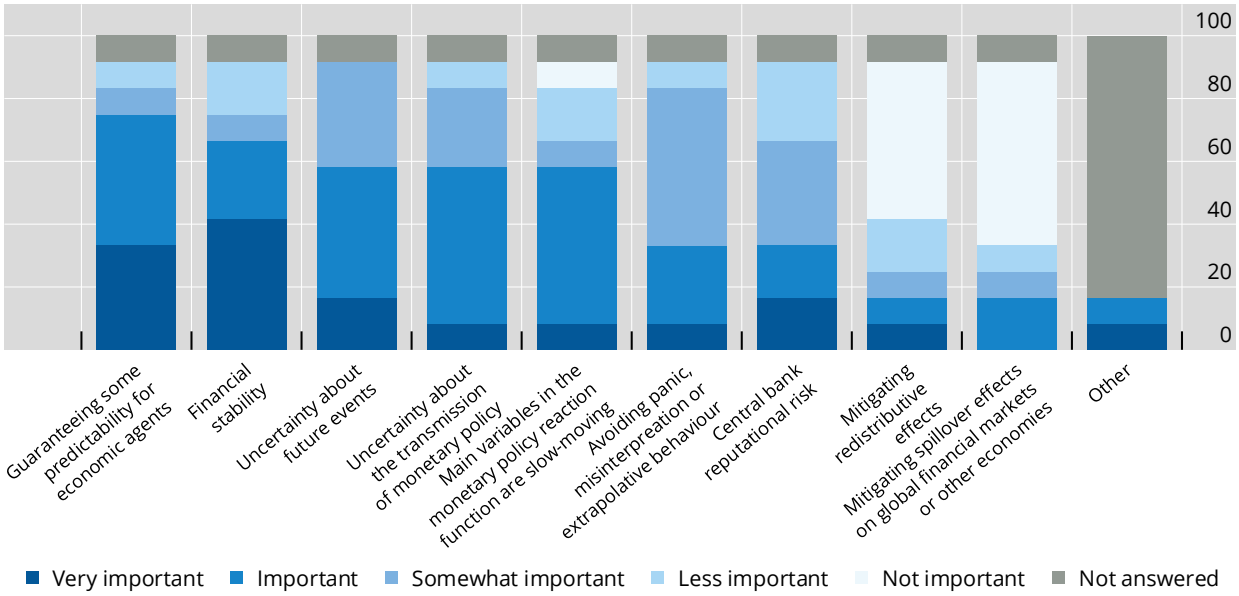
Differences emerge in the specific methods and institutional frameworks used to manage uncertainty. Some central banks highlight the diverse views within their decision-making boards, which can lead to varied approaches, including the use of alternative scenarios to address parameter uncertainty. Others incorporate periodic studies to reassess transmission mechanisms, leveraging tools like structural VAR models and sectoral indicators. Meanwhile, some institutions emphasise longer-term goals and risks to the financial system, integrating these considerations into their policy decisions.

In the face of uncertainty, central banks tend to adjust the policy rate in small steps. The two most important reasons mentioned to explain this behaviour were: (1) guaranteeing some predictability for economic agents; and (2) financial stability (Graph 4). Next, most central banks picked: (3) uncertainty about future events; and (4) uncertainty about the transmission of monetary policy. These answers suggest that central banks deliberately smooth policy rate changes.[6]

Reasons for adjusting the policy rate in small steps

As a percentage of respondents

Graph 4



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

Reasons considered somewhat important to central banks are: (5) main variables in the monetary policy reaction function are slow-moving;[7] (6) avoiding panic, misinterpretation or extrapolative behaviour; and (7) central bank reputational risk.

[6] This behaviour is theoretically justified by Brainard (1967), Goodfriend (1987), Sack and Wieland (2000) and Woodford (2003).

[7] Rudebusch (2006) and Carrillo et al (2007) point to the fact that some of the variables which monetary policy reacts to change slowly as explanation for the apparent smoothing of the policy rate.

Reasons viewed of little importance for explaining the smoothing behaviour of rate changes were: (8) mitigating redistributive effects; and (9) mitigating spillover effects on global financial markets or other economies. This shows that gradualism in central banks has not been justified in terms of the redistributive effects of monetary policy or a potential spillover to other economies, where the latter can be explained by the fact that most surveyed economies are not large enough to be systemic from a global perspective.

Central banks adopt varying strategies to make their monetary policy more robust during periods of heightened uncertainty, but common themes include cautious calibration, reliance on alternative models or scenarios, and gradual adjustments. A shared approach among many institutions is to proceed cautiously, often emphasising smaller, more gradual policy adjustments to avoid overreacting to transitory shocks or misjudging evolving conditions. This cautious stance is often communicated publicly, reinforcing transparency and anchoring expectations.

Some central banks use specific tools or adjustments to enhance robustness. For instance, wider ranges in published policy rate paths allow for flexibility in response to uncertain conditions, while alternative models – such as those incorporating endogenous monetary policy credibility – are used to better align policies with data. Similarly, adjustments to the speed and horizon of policy responses are optimised to manage inflation expectations when they deviate persistently from targets.

Differences emerge in how central banks respond to their unique economic contexts. For example, in 2024 the Bank of Mexico adopted a gradual approach to reducing the reference rate, taking into account disinflationary trends, weak economic activity and financial market volatility. In contrast, Argentina's history of high inflation requires a more contractionary stance under uncertainty to avoid inflationary surges and spiralling nominal variables. Meanwhile, Canada's response to unexpectedly strong inflation in 2022 included exploring alternative models to better capture economic dynamics.

Central banks recognise the value of high-frequency data (HFD), such as credit/debit card transactions, port activity and real-time employment indicators, in providing timely and granular insights into the economy. These data are particularly useful for nowcasting and monitoring short-term dynamics of economic activity and inflation and for detecting early signs of vulnerabilities. For instance, at the Central Bank of Chile, high-frequency indicators are constructed from granular, up-to-date administrative records on firm-level sales, consumer purchases and other variables to detect turning points and evaluate the impact of different shocks and policies.[8] However, central banks also acknowledge several limitations associated with HFD, such as volatility, noise, representativeness issues and methodological inconsistencies, which necessitate careful use to ensure robust decision-making.

A common challenge highlighted by many central banks is the high level of noise and volatility in HFD, which can obscure underlying economic trends and lead to overreaction if not managed carefully. To address this challenge, central banks use complementary techniques such as smoothing, filtering and cross-checking with more stable, lower-frequency data sets. For example, some institutions focus on identifying systematic co-movements or robust patterns within HFD to distinguish

[8] For more details, see https://www.bcentral.cl/en/w/uso-microdatos-politica-monetaria.

meaningful signals from noise. Additionally, HFD are often used as a complementary tool rather than as a replacement for traditional macroeconomic indicators.

Another limitation is the lack of coverage, representativeness and/or historical depth of HFD. This can make it difficult to assess their predictive value or determine their appropriate weight in decision-making. Central banks address these challenges by integrating HFD into broader models, such as nowcasting or short-term forecasting frameworks, and by contextualising HFD within macroeconomic trends to avoid overemphasising any single data series. Advanced technological infrastructure and skilled personnel are also necessary to process and integrate large and complex HFD data sets effectively (Bernanke (2024)).

Specific use cases of HFD vary across countries based on their economic contexts. For instance, the Central Bank of Argentina relies heavily on high-frequency inflation data, which primarily reflect goods prices rather than services prices, and complements them with forecasts and wage data to gain a fuller picture of CPI movements. Meanwhile, other central banks (eg Brazil) monitor HFD for real activity and financial flows to understand contagion channels or assess the impact of government policies.

While HFD provide valuable real-time insights, their limitations — such as volatility, representativeness issues and methodological challenges — require central banks to use them cautiously and in conjunction with traditional indicators. By employing statistical techniques, leveraging complementary data sets and integrating HFD into broader models, central banks enhance their ability to extract meaningful signals while mitigating the risks of overreaction or misinterpretation.

In summary, heightened uncertainty compels central banks to adopt a cautious and adaptive approach to monetary policy. While common strategies include gradual adjustments to policy rates, reliance on alternative models and the use of scenario analysis, differences emerge based on each central bank's specific economic circumstances and institutional structure. HFD are increasingly valued for their ability to provide real-time insights into economic dynamics, though their volatility and methodological challenges require careful interpretation. Ultimately, the survey responses highlight the importance of balancing caution and agility in monetary policy, ensuring that central banks maintain credibility and flexibility while addressing the unique challenges posed by uncertainty.

7. Forward guidance under uncertainty

The use of forward guidance as a non-interest rate policy tool in uncertain environments is seen by survey respondents as valuable; however, its effectiveness diminishes as uncertainty increases. As a result, central banks often adjust their forward guidance strategies during uncertain periods, shortening time horizons or using ranges to reflect the heightened risks.

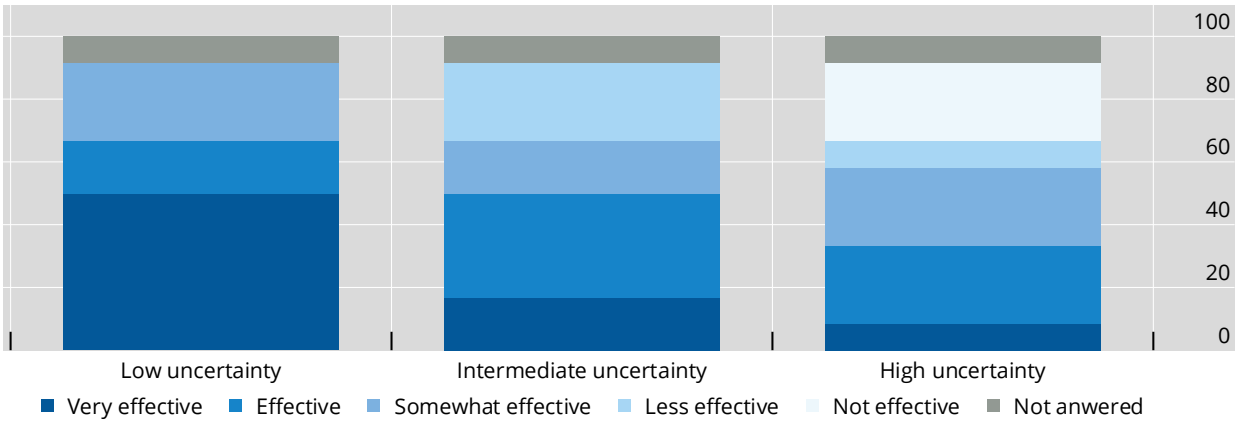
Central banks see an increased risk in providing forward guidance under heightened uncertainty, leading some to avoid offering it during such periods. One central bank highlighted that under heightened uncertainty, forward guidance might shift towards signalling a longer period of inaction. Another central bank reported adjusting the width of published forecast ranges to account for the increased uncertainty. Similarly, one institution reduced the precision of its forward guidance in response to greater uncertainty. However, the source of uncertainty plays a critical

role, as forward guidance may also be used as a tool to mitigate uncertainty specifically related to the central bank's reaction function.

Overall, central banks view forward guidance as most effective in low-uncertainty environments and least effective in high-uncertainty contexts, with several central banks mentioning that it is not effective in the latter case (Graph 5). When there is uncertainty related to the monetary policy reaction function (eg neutral rates), forward guidance may help the central bank to fulfil its mandate.[9] When the source of uncertainty is not in the hands of the central bank, providing forward guidance is riskier and may lock the central bank in a bad position. Alternatively, the central bank may signal a longer period of inaction or reduce the precision of the guidance.

How effective is forward guidance in an environment of uncertainty?

As a percentage of respondents — Graph 5



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

8. Central bank communication with the public under uncertainty

Central banks have continued to develop their communication as is evident from the press conferences some of them hold to explain their monetary policy decisions, as well as the regular monetary policy and inflation reports they publish. A key takeaway from the survey responses, however, is that communicating uncertainty is challenging (Bernanke (2024)). More frequent communication may not necessarily achieve clearer guidance. The survey responses show that many central banks have adapted their communication tools and channels in response to heightened uncertainty to increase the effectiveness of communication. These adjustments also reflect lessons learned from the Covid-19 pandemic, which was a forced laboratory for how central banks deal with heightened and fundamental uncertainty.

As part of their communication with markets and the broader public, all 12 central banks regularly publish monetary policy or inflation reports, with most doing

[9] For a perspective on how a central bank can publish alternative future scenarios alongside signalled paths for the policy rate, see Seim (2025).

so quarterly.[10] How uncertainty around possible outcomes is reflected, however, varies. Tools such as fan charts, scenario analysis, conditional forecasts and subjective probability distribution are widely used to communicate uncertainty (Graph 6). Challenges persist in making these concepts accessible to market participants and, even more so, to the general public. While visualisation tools are considered somewhat effective, many central banks reported that audiences tend to focus on point forecasts and often neglect the uncertainty around these point forecasts.

In the context of inflation forecasts, eight out of the 12 surveyed central banks publish inflation forecasts, either quantitative or qualitative, by staff in their monetary policy report, inflation report or monetary policy meeting minutes. Of these eight, six provide not only point forecasts but also confidence intervals to communicate the degree of uncertainty around these forecasts. This, however, does not mean that forecasts are made without board oversight or advice. Notably, at the Central Bank of Chile, inflation forecasts are prepared by the staff but formally endorsed and owned by the monetary policy board.

A different picture emerges for policy rate forecasts. Only three of the surveyed central banks publish policy rate forecasts made by the staff. The South African Reserve Bank and Central Bank of Uruguay both provide point forecasts, but only the Central Bank of Uruguay includes confidence intervals around them as well. The Central Bank of Colombia provides a brief qualitative description of the forecast rate path in relation to analysts' forecasts (eg greater or lower on average).

While staff forecasts are an important means to convey uncertainty around projections that feed into monetary policy decisions, the views of board or monetary policy committee members can provide another complementary perspective. Seven central banks, however, do not publish inflation forecasts prepared by board or monetary policy committee members. The central banks of Brazil, Canada, Chile and South Africa do, but only one average/consensus forecast. The Federal Reserve publishes the quarterly Summary of Economic Projections (SEP), which shows anonymous distributions of Federal Open Market Committee (FOMC) participants' individual projections on Personal Consumption Expenditures (PCE) and core PCE inflation.

Similar to inflation forecasts, nine out of 12 central banks do not publish policy rate forecasts by board or monetary policy committee members. The Central Bank of Chile publishes a policy rate corridor that reflects the consensus view of its board members on possible future trajectories for the policy rate, which incorporates the central forecast scenario as well as sensitivity scenarios capturing different types of uncertainty (initial state of the economy, future shocks, neutral rate). The South African Reserve Bank provides regular guidance on the trajectory of the policy rate by communicating post-judgment projections from its Quarterly Projection Model. The Federal Reserve publishes in its SEP the dot plot of anonymous individual projections on the federal funds rate by board members.

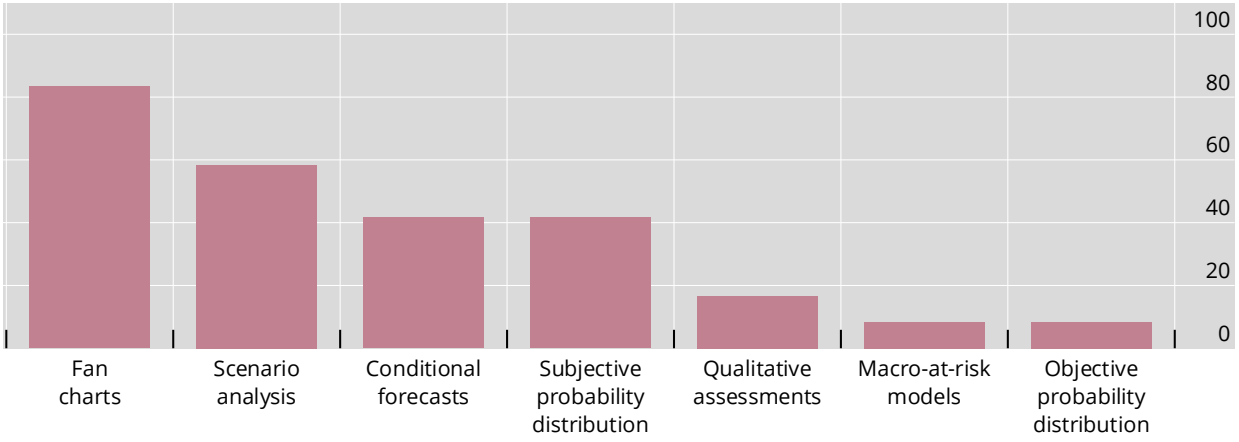
In communicating uncertainty in central banks' projections, fan charts are the most widely used tool, followed by scenario analysis, conditional forecasts and subjective probability distributions (Graph 6). The Central Bank of Brazil maintains in some of its regular communication a permanent section on the balance of qualitative

[10] The Central Bank of Argentina publishes a Monthly Monetary Report and the Federal Reserve a semi-annual Monetary Policy Report to Congress.

risks to inflation. The Central Bank of Chile publishes fan charts for indicators of inflation and economic activity, and for the policy rate it provides a combined fan chart and sensitivity scenario-based corridor..[11] The Federal Reserve publishes in its SEP a distribution of the FOMC members' assessments of uncertainty embedded in forecasts compared with the level observed in the past 20 years. The Central Bank of the Republic of Türkiye holds face-to-face meetings with firms and publishes graphical analyses based on these interviews. Some central banks also rely on other instruments in times of heightened uncertainty, such as qualitative assessments and macro-at-risk models. In addition, most central banks publish scenarios to convey uncertainty. These scenarios are generally based on quantitative characteristics – only one central bank focuses on qualitative scenarios. All central banks find these tools somewhat effective in communicating uncertainty to non-technical audiences.

Visualisation tools to communicate uncertainty projections in central bank reports

As a percentage of respondents Graph 6



Source: CGMP survey on central bank monetary policy decision-making and communication under heightened uncertainty in 2025.

Despite the various visual and other tools available, all central banks find it challenging to communicate uncertainty. While most central banks see communicating uncertainty to market participants as somewhat challenging, with a few describing it as very challenging, they view communicating uncertainty to the public as even more challenging. The importance of tailoring messages to specific audiences was highlighted, alongside concerns about misinterpretation (eg market participants misreading median forecasts or focusing on worst-case scenarios).

The survey responses clearly show that central banks have changed their communication strategies and tools in periods of heightened uncertainty. Most central banks have taken measures such as broadening the size of fan chart bands or publishing alternative scenarios during periods of heightened uncertainty. Alternatively, one central bank has adjusted its forward guidance by limiting or modulating the language used, thereby providing more qualitative signals about the

[11] To communicate tail risks that are hard to quantify, the Central Bank of Chile explicitly identifies such scenarios as having lower probability and suggests that they may imply a significantly different monetary policy reaction. For details, see https://www.bcentral.cl/documents/33528/2246274/Uso_de_modelos_en_el_BCCh_2020.pdf.

future path of the policy rate. Another central bank reflected that its public projections inherently incorporate the uncertainty and asymmetry of the prevailing scenario.

In some cases, qualitative assessments have been employed to address uncertainty. During the Covid-19 pandemic, one central bank took the unusual step of halting the publication of a "central" (most likely) scenario within its fan chart. Instead, it acknowledged operating under "Knightian" (fundamental) uncertainty and provided ranges for key endogenous and exogenous macroeconomic variables based on broad assumptions about exogenous factors. Similarly, during the pandemic, another central bank published output and inflation forecasts under alternative scenarios, a strategy explicitly reserved for the extraordinary circumstances. In addition, one central bank communicates uncertainty by publishing histograms that reflect its monetary policy committee participants' assessments of risks and uncertainty.

One prominent concern about communicating uncertainty is whether it gets "lost in translation". Many central banks reported that economic agents often focus on point forecasts, overlooking the broader context of uncertainty depicted in a distribution of forecasts. To address this, one central bank features a balance of risks section in its monetary policy post-meeting communication and minutes – a segment closely scrutinised by market participants – as a key communication tool for conveying uncertainty. Similarly, another central bank observed that, during recent periods of heightened volatility, economic agents and market participants have tended to prioritise the specific quarter when projected inflation is expected to align with the target, rather than examining the underlying drivers or assumptions behind these projections. In contrast, one central bank noted that while analysts often concentrate on point forecasts, some do pay attention to probability distributions (predictive densities) for inflation and the output gap. To enhance understanding, this central bank actively emphasises the risks associated with forecasts and their implications for inflation and policy interest rates. Meanwhile, another central bank observed that external audiences may not fully grasp the broader implications of heightened uncertainty, particularly its influence on monetary policy beyond complicating the central bank's forecasting task. It is worth noting, however, that not all central banks publish forecasts.

In press conferences, speeches or minutes published after monetary policy decisions, most central banks explicitly communicate aspects of uncertainty in their decisions, while others do so only occasionally. One central bank provides qualitative descriptions in press conference remarks, speeches, testimonies, post-meeting statements and minutes. Another central bank mentioned that this happens in special circumstances of heightened uncertainty.

Regarding how often central banks communicate with the public, four central banks indicated that heightened uncertainty did not affect the frequency of their communication with the public. However, two central banks reported communicating more frequently than usual, while three noted that the frequency depends on the nature of the uncertainty. For example, during the Covid-19 pandemic, one central bank increased the number of its policy meetings and public statements from eight to 12 annually, before eventually returning to eight. Another central bank also reported more frequent communication during this period. One central bank highlighted that it issues a press release every month for each monetary policy meeting, detailing the decision and its rationale, followed by a press conference for further clarification. The only exception was March 2020, when it issued an additional

press release in response to the pandemic. Notably, no central bank reported a reduction in communication frequency during heightened uncertainty.

Finally, central banks monitor economic news related to central bank communication, market reactions within a time window around a central bank publication or announcement, and information from institutional communication channels with market participants. One central bank pays attention to its expectations surveys, while another one reaches out directly to contacts spread across its country.

9. Conclusion

The survey results provide new insights into how central banks navigate the complexities of monetary policy decision-making and communication under heightened uncertainty. These findings underscore the significant impact of uncertainty on shaping central banks' strategies, particularly in their efforts to maintain financial stability and guide economic agents through unpredictable environments.

High levels of uncertainty naturally present challenges for monetary policy decision-making, as financial market dynamics, including FX market developments, and the macroeconomic backdrop can change fundamentally in a short period of time. To address these challenges, central banks are increasingly leveraging advanced tools such as scenario analysis, high-frequency data and AI/ML techniques to enhance their understanding of rapidly evolving economic dynamics and improve the timeliness of their assessments. Despite these advancements, expert judgment remains critical, as it allows policymakers to interpret model outputs, account for limitations and incorporate qualitative insights when making decisions in uncertain environments.

Moreover, the survey results imply that central banks cope with this complex situation by taking a cautious approach of adjusting policy rates in small, incremental steps. This gradualism reflects the need to maintain financial stability and to provide a degree of predictability for economic agents in uncertain times. Predictability has its limits in times of uncertainty, however, as the more restricted use of forward guidance shows.

Central banks are also divided on the importance of the central scenario during periods of extreme uncertainty. While some institutions prioritise alternative scenarios to address large, realised shocks such as the Covid-19 pandemic, others view the central scenario as a crucial anchor for providing stability and predictability to economic agents.

While central banks have made progress in communicating uncertainty, the survey results underscore that challenges remain in ensuring that market participants and the public fully understand its implications for monetary policy, for both related decisions and projections. Sophisticated visualisation tools, including fan charts and probability distributions, are being integrated into regular monetary policy and inflation reports to better communicate uncertainty. This points to the need for continued improvement in communication strategies, with an emphasis on tailoring messages to diverse audiences and raising awareness of the broad role that uncertainty plays in shaping the economy.

The findings in the chapter emphasise the need for robust analytical frameworks, cautious yet flexible policymaking and clear communication strategies. By presenting

the results of a direct survey of 12 central banks, this chapter contributes to a deeper understanding of how central banks manage uncertainty and can offer options for the central banking community on how to deal with uncertainty. The following chapters in this volume contributed by 10 central banks provide a more detailed view of individual institutions and their specific challenges and solutions.

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Appendix A – survey questions

Section 1: Central bank publications and communication with the public under uncertainty

This section focuses on how central banks communicate uncertainty to the public through their publications, press releases and press conferences. Which tools are used (eg scenarios) and how is uncertainty reflected in communicating the monetary policy stance (eg forward guidance)? What are the challenges in making complex concepts accessible to diverse audiences?

1. Does your institution regularly publish monetary policy/inflation reports prepared by staff?
    - ( ) No
    - ( ) Yes, on a regular basis but not with every monetary policy meeting
        - At which frequency?

          _____
    - ( ) Yes, with every monetary policy meeting
    - ( ) Other:

      _____
2. Does your institution publish *inflation forecasts* by staff in monetary policy/inflation reports?
    - ( ) No
    - ( ) Yes, but only point forecasts
    - ( ) Yes, both point forecasts and confidence intervals around the point forecasts
    - ( ) Other:

      _____
3. Does your institution publish *policy rate forecasts* by staff in monetary policy/inflation reports?
    - ( ) No
    - ( ) Yes, but only point forecasts
    - ( ) Yes, both point forecasts and confidence intervals around the point forecasts
    - ( ) Other:

      _____
4. Does your institution publish *inflation* forecasts by *board or monetary policy committee* members?
    - ( ) No
    - ( ) Yes, but only one average/consensus forecast
    - ( ) Yes, forecasts of individual members or forecast intervals
    - ( ) Other:

      _____

5. Does your institution publish *policy rate* forecasts by *board or monetary policy committee* members?

    - ( ) No
    - ( ) Yes, but only one average/consensus forecast
    - ( ) Yes, forecasts of individual members or forecast intervals
    - ( ) Other:

      _____

6. What visualisation tools are used by your institution to communicate uncertainty in your projections published in relevant reports? (Select all that apply)

    - ( ) Fan charts (probability/confidence intervals)
    - ( ) Objective probability distributions (eg based on mathematical models)
    - ( ) Subjective probability distributions (eg based on surveys)
    - ( ) Conditional forecasts (eg conditioning on assumptions about the trajectory of other variables)
    - ( ) Scenario analysis
    - ( ) Macro-at-risk models (eg inflation-at-risk, growth-at-risk)
    - ( ) Qualitative assessments (additional or stand-alone)
    - ( ) Other (please specify):

      _____

7. Does your institution find it challenging to communicate uncertainty to market participants?

    - ( ) Very challenging
    - ( ) Somewhat challenging
    - ( ) Not challenging
    - ( ) Not applicable

8. Does your institution find it challenging to communicate uncertainty to the general audience?

    - ( ) Very challenging
    - ( ) Somewhat challenging
    - ( ) Not challenging
    - ( ) Not applicable

9. Does your institution find visualisation tools to be effective in conveying uncertainty to non-technical audiences?

    - ( ) Very effective
    - ( ) Somewhat effective

- ( ) Not effective
- ( ) Not used

10. If your institution publishes scenarios, are qualitative scenarios used alongside quantitative ones in its communication strategy to convey uncertainty?
    - ( ) It does not publish scenarios
    - ( ) It publishes only quantitative scenarios
    - ( ) It publishes only qualitative scenarios
    - ( ) It publishes both qualitative and quantitative scenarios
    - ( ) Other (please elaborate):
      _____
      _____
      _____
      _____
      _____
11. Has your institution made changes to the presentation of projections and scenarios during periods of heightened uncertainty? (Select all that apply)
    - ( ) Broadened the size of fan chart bands
    - ( ) Published alternative scenarios
    - ( ) Other (please specify)
      _____
      _____
      _____
      _____
12. Does uncertainty get lost in translation? For example, do economic agents or market participants focus only on point forecasts instead of understanding the broader context of uncertainty or the distribution of potential outcomes?
    - ( ) Yes
    - ( ) No
    - ( ) Sometimes (please elaborate):
      _____
      _____
      _____
      _____
      _____
13. In press conferences, speeches or minutes published after the monetary policy decision, does your institution communicate the level and nature of uncertainty and how it affected the decision?
    - ( ) Yes

- ( ) No
- ( ) Sometimes (please elaborate):
  _____
  _____
  _____
  _____
  _____

14. At times of heightened uncertainty, how often has your central bank communicated with the public? (Select one)
    - ( ) More often than usual
    - ( ) Less often than usual
    - ( ) About the same as usual
    - ( ) It depends on the nature of the uncertainty (please elaborate):
      _____
      _____
      _____
      _____
      _____
15. Which type of data/information from markets, firms or other economic agents does your institution consider when it announces changes in its perception of uncertainty? (Select all that apply)
    - ( ) Economic news/statements related to central bank communication
    - ( ) Direct/real-time observation of market reactions within a time window around a central bank publication or announcement
    - ( ) Market participants' information collected from institutional communication channels
    - ( ) Other (please describe):
      _____

Section 2: Uncertainty and monetary policy reaction function

This section explores how uncertainty influences monetary policy decisions, including the calibration of the policy rate and the trade-offs between gradual and forceful adjustments.

16. Does your monetary policy reaction function explicitly account for uncertainty in the transmission of monetary policy?
    - ( ) Yes
    - ( ) No
    - ( ) Not explicitly, but indirectly

    (optional) In particular, how do you calibrate monetary policy in the face of uncertainty about the strength and lags of monetary policy

transmission? How does your institution reconcile the tension between monetary policy agility and the lagged effects of monetary policy on the economy?

_____
_____
_____
_____

17. Central banks tend to adjust the policy rate in small steps. Rank the most important reasons for this behaviour in the following order (1 = most important, 5 = least important, there can be more than one reason with the same ranking position):
    - ( ) Financial stability
    - ( ) Guaranteeing predictability for economic agents
    - ( ) Uncertainty about the transmission of monetary policy
    - ( ) Uncertainty about future events
    - ( ) Main variables in the monetary policy reaction function are slow-moving
    - ( ) Other
      _____

    (optional) In particular, how does this behaviour change during periods of heightened uncertainty?

    _____
    _____
    _____
    _____

18. Does your institution change its monetary policy strategy to make it more robust when under heightened uncertainty? If so, could you describe instances where your decisions were influenced by this strategy?
    - ( ) Yes (please elaborate):
      _____
      _____
      _____
    - ( ) No
19. What are the limitations of using high-frequency data (eg credit/debit card transactions, port activity, real-time employment data) in monetary policy decision-making, and how do you address these challenges?

Section 3: Forward guidance under uncertainty

This section examines how central banks adapt their use of non-interest rate policy tools, such as forward guidance, in the face of heightened uncertainty. It

also evaluates the effectiveness of these tools under different conditions.

20. How does heightened uncertainty affect the use of forward guidance in your central bank?

    - ( ) We avoid providing forward guidance in such periods
    - ( ) We use ranges rather than point guidance
    - ( ) We shorten the horizon of the guidance
    - ( ) We do not change our forward guidance strategy
    - ( ) Other (please specify):

      _____
      _____
      _____

21. How effective is forward guidance in an environment of high uncertainty? (Rate on a scale of 1–5, where 1 = not effective and 5 = very effective)

22. How effective is forward guidance in an environment of intermediate uncertainty? (Rate on a scale of 1–5, where 1 = not effective and 5 = very effective)

23. How effective is forward guidance in an environment of low uncertainty? (Rate on a scale of 1–5, where 1 = not effective and 5 = very effective)

Section 4: Capturing and quantifying uncertainty in economic analysis by central banks

This section examines the tools, techniques and frameworks central banks use to measure and incorporate uncertainty in their economic analysis. It also considers how uncertainty is presented in internal discussions.

24. Do you find that the central scenario becomes less relevant during periods of extreme uncertainty, leading to greater reliance on alternative scenarios?

    - ( ) Yes
    - ( ) No
    - ( ) Sometimes (please elaborate):

      _____
      _____

25. Rank the following types of uncertainty from most frequently discussed (1) to least frequently discussed (4) recently on average in your board meetings. (List only those that apply.)

    - ( ) Statistical uncertainty (eg measurement errors, data revisions)
    - ( ) Known unknowns (eg risks from geopolitical events, policy changes)

- ( ) Unknown unknowns (eg unforeseen shocks like the pandemic)
- ( ) Other (please specify): _____

26. On a scale from 1 to 5, how important is each of the following criteria or indicators for your institution in identifying periods of heightened uncertainty? (1 = not important, 5 = very important)
    - ( ) Financial market volatility (including exchange rate)
    - ( ) Forecast errors
    - ( ) Confidence indices
    - ( ) Qualitative judgment by staff or an internal committee
    - ( ) Other (please specify): _____
27. Does your institution use any of the following tools to quantify uncertainty? (Select all that apply.)
    - ( ) Confidence intervals
    - ( ) Fan charts
    - ( ) Objective probability distributions (eg based on mathematical models)
    - ( ) Subjective probability distributions (eg based on surveys)
    - ( ) Conditional forecasts (eg conditioning on assumptions about the trajectory of other variables)
    - ( ) Macro-at-risk models (eg inflation-at-risk, growth-at-risk)
    - ( ) Scenario analysis
    - ( ) Qualitative assessments
    - ( ) Other (please specify): _____
28. How does your institution account for atypical or asymmetric risks that may not be captured by historical data?
29. How does your institution address the challenge of distinguishing between structural and cyclical sources of uncertainty? How does your institution determine whether shocks are supply-driven, demand-driven, or a combination of both? What tools or frameworks do you find particularly useful in such contexts?

Section 5: Incorporating uncertainty into models and tools

This section focuses on how central banks integrate uncertainty into their economic models and analytical tools, including the use of high-frequency data and advanced techniques like scenario analysis.

30. Choose the most relevant sources of uncertainty in modelling choices for the monetary policy transmission mechanism (select all that apply):
    - ( ) Wage-price relationship
    - ( ) Output gap to prices
    - ( ) FX pass-through
    - ( ) Monetary policy power
    - ( ) Other (please specify):
      _____
31. Does your institution provide probability distributions around mean or mode predictions in economic forecasts made to the board?
    - ( ) Yes
    - ( ) No
    - ( ) Sometimes (please elaborate):
      _____
      _____
      _____
      _____
32. If you use fan charts, please describe how you compute their bands. Are they:
    - ( ) Objective (eg based on past forecast errors or estimated model standard errors)?
    - ( ) Subjective (eg based on a survey among senior staff)?
    - ( ) A combination of both? (please explain):
      _____
33. How frequently does your institution use scenario analysis to evaluate alternative economic scenarios or trajectories?
    - ( ) Regularly (eg every projection round)
    - ( ) Occasionally (eg during times of heightened uncertainty)
    - ( ) Rarely
    - ( ) Never
34. Do you adjust measures of underlying inflation to account for exceptional shocks that increase uncertainty (eg supply bottlenecks, energy price surges due to geopolitical conflicts)?
    - ( ) Yes
    - ( ) No
    - ( ) Sometimes (please elaborate):
      _____

35. Does your institution use artificial intelligence (AI) or neural network models to analyse high-frequency data for detecting turning points in the economy?
    - ( ) Yes
    - ( ) No
    - ( ) Currently exploring (please elaborate):
      _____
      _____
      _____
      _____
      _____
36. Does your institution evaluate the uncertainty over assumptions and the uncertainty over modelling?
    - ( ) Only uncertainty over assumptions
    - ( ) Only uncertainty over modelling
    - ( ) Both uncertainties
    - ( ) None of them
37. How do you incorporate judgment-based adjustments to complement model-based outputs in times of elevated uncertainty?

Section 6: The role of scenario analysis (staff analysis)

This section investigates the role of scenario analysis for internal purposes, including the development and prioritisation of scenarios. It seeks to understand how central banks use scenarios to explore potential economic outcomes.

38. If your institution uses scenario analysis, what type of scenarios are you currently looking at (please mark all that apply)?
    - ( ) geopolitical risk shock
    - ( ) trade/tariff shock
    - ( ) capital flow shock
    - ( ) FX rate shock
    - ( ) oil price shock
    - ( ) other commodity price shock
    - ( ) consumer demand shock
    - ( ) labour supply shock (eg migration, pandemic)
    - ( ) fiscal shock
    - ( ) inflation shock

- ( ) monetary policy transmission shock
- ( ) financial sector shock
- ( ) Other (please specify):

  _____

39. How do you prioritise between the scenarios you analyse?
    - ( ) likelihood of a given shock
    - ( ) potential severity of a shock
    - ( ) potential macroeconomic impact
    - ( ) by request of the board
    - ( ) scenarios viewed as important by market participants
    - ( ) scenarios viewed as important by the media
    - ( ) Other (please specify):

      _____

40. Rank the most important sources of current uncertainty for constructing different scenarios in the following order (1 = most important, 5 = not important, there can be more than one source with the same ranking position):
    - ( ) Exchange rates (FX)
    - ( ) Oil prices
    - ( ) Commodities other than oil
    - ( ) Trade and tariffs
    - ( ) Migration and remittances
    - ( ) Geopolitical events
    - ( ) Neutral rate
    - ( ) Inflation
    - ( ) Output gap
    - ( ) Other (please specify):

      _____

41. If your institution uses scenario analysis, do you incorporate market-based conditioning assumptions (eg option-implied densities for commodity prices) in constructing your scenarios?
    - ( ) Yes
    - ( ) No

The economic impact of uncertainty: transmission channels and modelling issues underpinning Argentina's new monetary framework

Vladimir Werning (Central Bank of Argentina[1])

1. Introduction

This note illustrates how uncertainty affects the monetary policy framework along three dimensions – model structure, macroeconomic inputs and policy reaction – and highlights the central role of the foreign exchange (FX) channel in a bi-monetary economy like Argentina's. It provides a context by highlighting the impact of uncertainty stemming from the election cycle on money demand and the policy response to this adverse shock.

This source of cyclical uncertainty and its effect on monetary management is analysed in consideration of structural sources of uncertainty, namely the process of change in monetary regime. While monetary aggregate targeting was adopted in 2024, important steps were taken to improve the M2 targeting framework in 2025. This transition involved incorporation of greater FX and interest rate flexibility. Recent developments reveal a promising decline of real interest rate levels and volatility alongside the preservation of well-anchored inflation expectations.

2. Dealing with sources of uncertainty

In 2025, the Central Bank of Argentina (BCRA) adopted an M2 monetary aggregate target compatible with FX flexibility within bands and market-determined overnight interest rates. Uncertainty affects multiple aspects of monetary policy: defining the rules that govern the model framework, projecting the macroeconomic outlook that guides expectations and exercising discretion when managing event risk. This note considers all three dimensions and conceptually describes the monetary channels through which uncertainty transmits to macroeconomic outcomes. The understanding of the relative importance of different monetary channels (interest rate and FX market) is complemented by quantifying recurring empirical shocks (eg elections and droughts).

The first consideration is the recognition that mapping and managing uncertainty always depends on context and that different paradigms are useful for different contexts. In a standard environment, it is useful to consider uncertainty in the following simple paradigm: "equilibrium, disturbance, response, convergence". In other situations, for example crisis resolution or regime transition, uncertainty is

[1] Based on remarks at the meeting of the BIS CCA Consultative Group on Monetary Policy in Mexico City on 2–3 October 2025. All views expressed are the author's own and do not necessarily represent those of the Central Bank of Argentina.

better understood and managed considering a different paradigm: "disequilibrium, unsustainability, adjustment, convergence", in which the interaction of monetary policy with other policies, and not monetary policy alone, becomes important.

The second consideration is the importance of distinguishing multiple sources of uncertainty. Uncertainty affecting the model framework is different from the uncertainty affecting macroeconomic inputs and the uncertainty affecting economic policy decisions.

The first pillar of monetary policy, establishing the model structure (ie the basic rules), is subject to two sources of uncertainty: (i) the robustness of parameters within the regime – reducing uncertainty surrounding the unobserved values of model parameters requires efforts to update and refine best-fit estimations – and (ii) if regime switching is relevant, authorities additionally face uncertainty over the changes of model parameters across different states of the economy or policy regimes.

Second, defining a baseline macroeconomic outlook is important for guiding market expectations. In selecting macro variables as inputs, we distinguish two sources of uncertainty related to predictability and the size of the impact. Variables may have well-behaved probability distributions and an "epsilon-size" impact on the path of monetary equilibrium and be easily incorporated into models. In contrast, variables or binary events that constitute tail risks can generate a "sigma-size" impact on the path of monetary equilibrium – that is, shocks with low probability but of large size. This uncertainty cannot be easily incorporated into models.

Third, monetary policy is affected by uncertainty when, given a central bank's reaction function, authorities exercise judgment and policy discretion. In real-time decision-making, many factors can bring uncertainty to policy actions: statistical measurement issues, signal extraction problems and policy trade-offs. This uncertainty increases when policy is required to respond to event risk. Therefore, monetary policy requires discretionary risk management response to rapidly unfolding developments.

The BCRA's current monetary framework is based on targeting a monetary aggregate (M2) as the nominal anchor and involves flexibility (within a widening band) in the FX market and overnight interest rate market, introduced in April and July 2025, respectively. The BCRA relies on a set of models calibrated to project real money demand, including projections of liquidity, fiscal performance, the credit market and the external sector. Graph 1 provides a schematic representation.

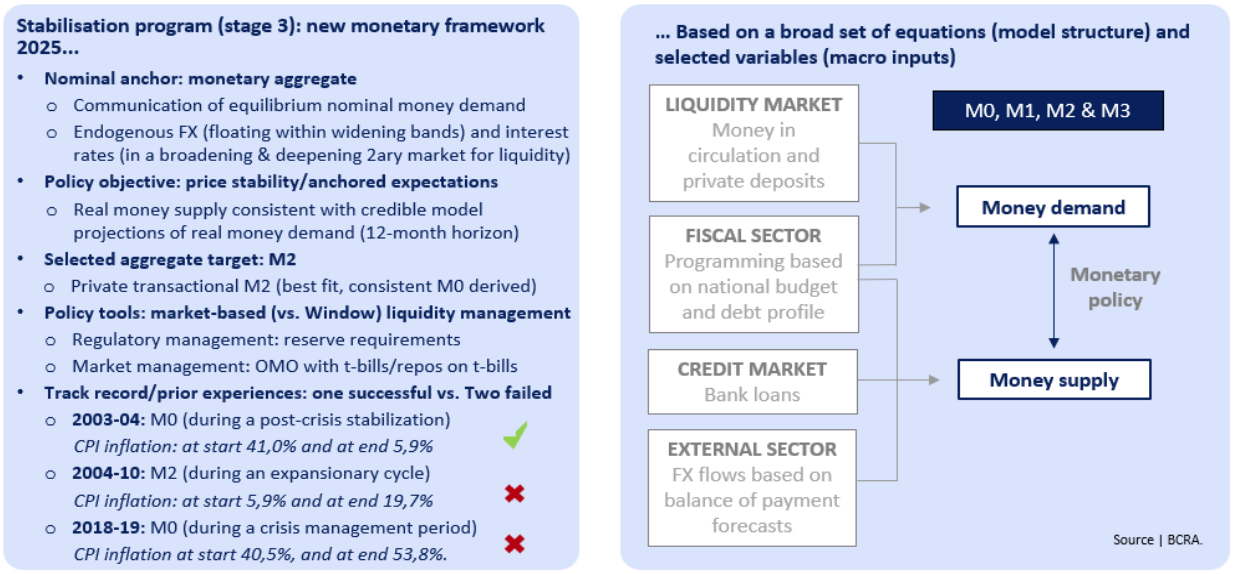
When incorporating macroeconomic outlook assumptions into the model, the BCRA must deal with two types of uncertainty:

- Epsilon-size (bounded) uncertainty: shocks with limited dispersion that can be incorporated within the model's baseline and represented in a fan chart (eg small fluctuations in circulation or sight deposits). This uncertainty is represented in model outputs.
- Sigma-size (tail-risk/unbounded) uncertainty: low-probability, large-impact events (fat tails) that may lie outside the model's forecast distribution. Examples for Argentina are major weather shocks (droughts) affecting agricultural exports and political/election events that, given the bi-monetary nature of the economy, may trigger abrupt portfolio rebalancing to the Argentine peso (ARS) and away from the US dollar (USD) or vice versa. These events must be treated as contingencies and embedded into the policy

reaction function, as incorporating them into baseline projections would render model outputs impractical.

A schematic representation of the BCRA's monetary framework

Graph 1

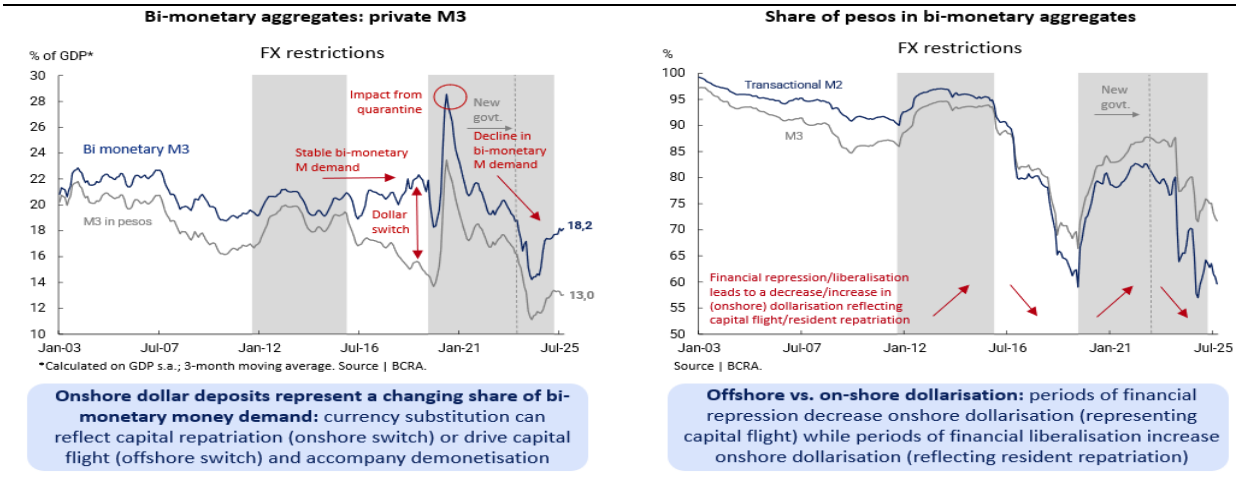


Source: Central Bank of Argentina (BCRA).

An important feature of a bi-monetary regime that imposes an additional constraint on monetary policy management is the unconventional response of money demand to risk aversion (Graph 2). Faced with rising uncertainty, domestic currency-based economies tend to experience an increase in money demand: "cash is king" drives portfolio decisions. In contrast, in bi-monetary economies the opposite occurs: "dollar is king" drives portfolio rebalancing, implying that local money demand declines. This inverse relationship between uncertainty and local currency demand in Argentina highlights the importance of distinguishing uncertainty affecting variables that are well behaved from uncertainty affecting variables that define binary scenarios.

Key features of the BCRA's bi-monetary regime

Graph 2



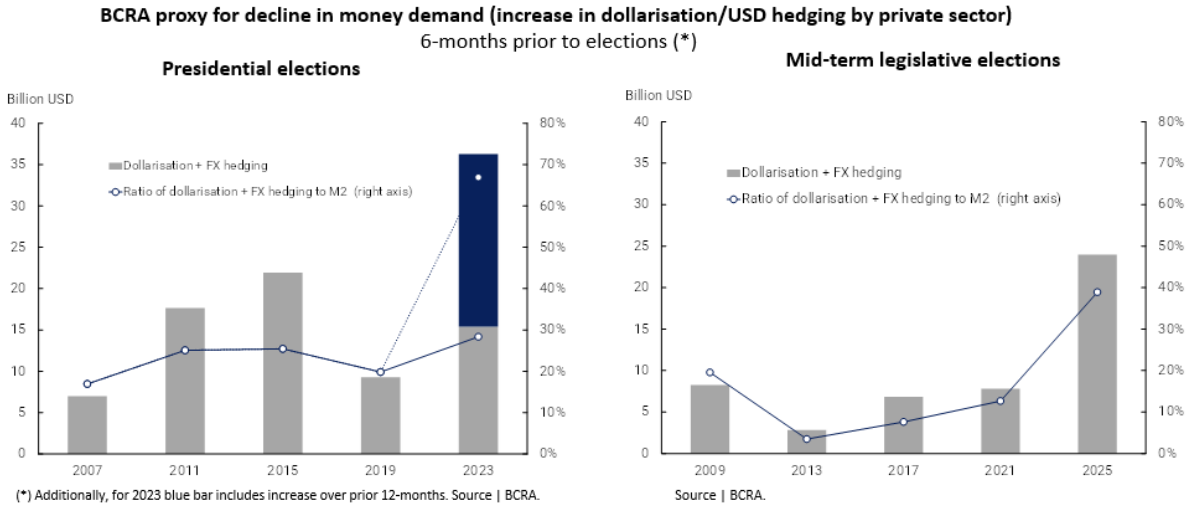
Source: Central Bank of Argentina (BCRA).

3. Transmission channels: the pivotal role of FX in a bi-monetary economy

Considering the substitution of ARS by USD as a "safe asset", the impact of uncertainty through the FX market and the transmission channel of monetary policy is of foremost importance. Uncertain event risk in Argentina can alternatively affect the expected supply of or demand for foreign currency.

- FX demand channel (currency rebalancing of portfolios): elevated uncertainty (political or macro) shifts private portfolios towards USD, reducing peso money demand. Graph 3 summarises empirical estimates where mid-term election episodes typically reduce peso transactional M2 by 15–30%; notably, the 2025 mid-term negative shock is estimated at about 40% of M2 (a measure that includes dollarisation through the spot FX market and other forms of hedging demand, like FX futures and USD-linked securities. These magnitudes materially alter the monetary equilibrium and have required out of the ordinary policy responses.
- FX supply channel (currency availability from export flows): adverse weather shocks lower foreign exchange inflows from agricultural exports (about 36% share of exports), compressing FX supply and reinforcing currency substitution through expectations of lower national income and limited smoothing via external markets (Graph 4). Commodity price volatility also imposes significant uncertainty.

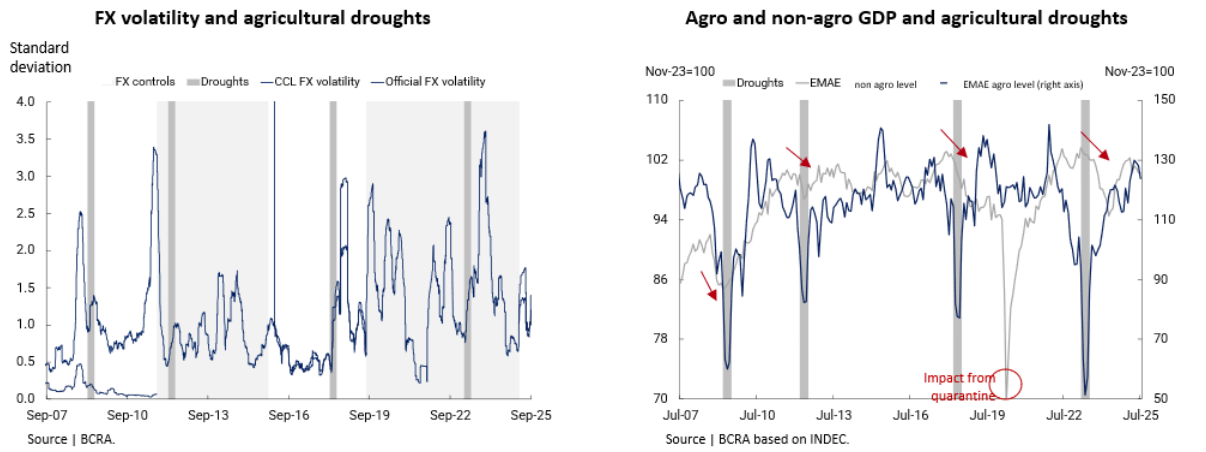
FX demand channel — Graph 3



Source: Central Bank of Argentina (BCRA).

FX supply channel

Graph 4



Source: Central Bank of Argentina (BCRA).

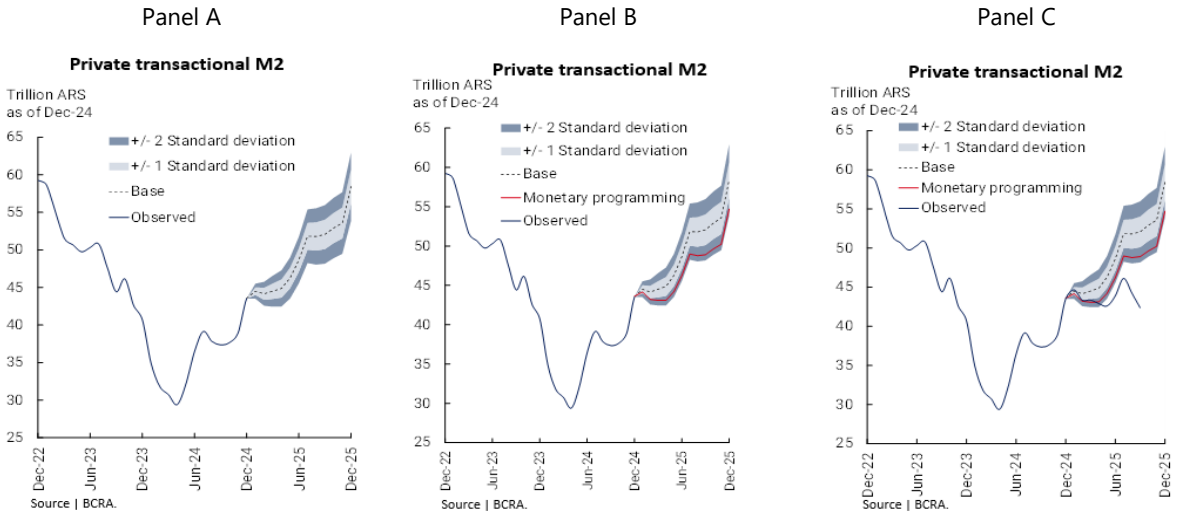
4. The monetary policy framework under uncertainty: features, evolution and results

The monetary policy framework inaugurated at end-2023 and the management of monetary policy in 2025 can be explained within the context of the preceding discussion on the impact of economic uncertainty.

Uncertainty affecting the path for the nominal anchor: The BCRA defined a monetary aggregate target (private transactional M2) to communicate the equilibrium path for nominal money demand over a 12-month horizon (Graph 5.A). This communication was based on a baseline model output for money demand with the standard depiction of bounded uncertainty.

The BCRA's monetary aggregate target

Graph 5



Source: Central Bank of Argentina (BCRA).

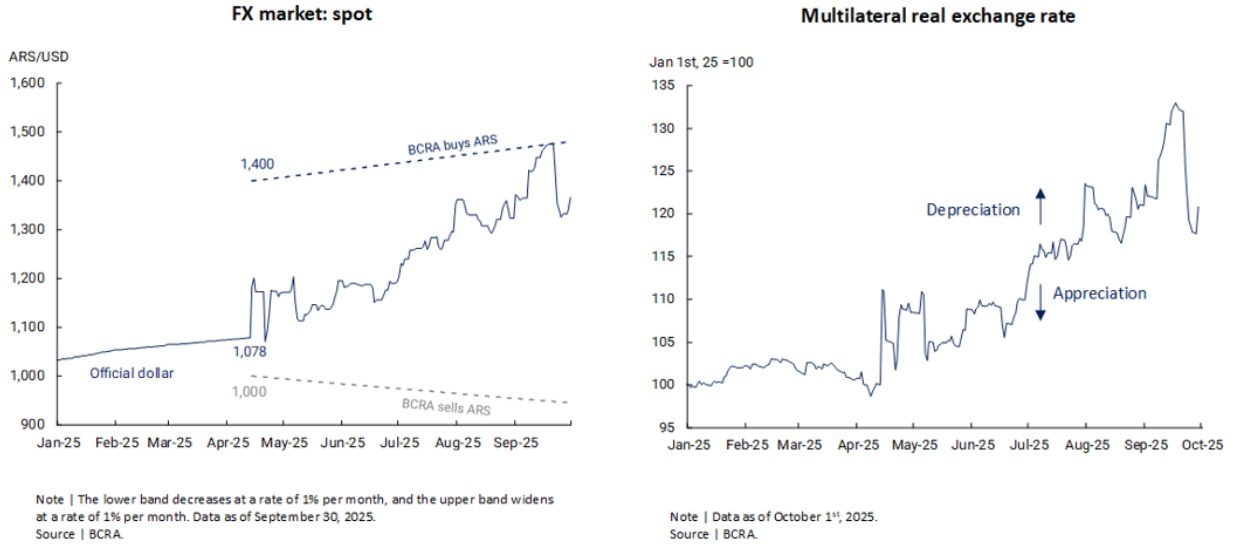
In consideration of uncertainty around model projections of money demand, the BCRA also provided forward guidance of a tight policy bias (ex ante): given the objective of furthering the disinflation process, the BCRA additionally communicated an ex ante path for money supply compatible with a tight monetary policy bias – two standard deviations below the path for baseline money demand (Graph 5.B).

Uncertainty stemming from regime transition (more flexible FX and interest rate policy): In April 2025, the BCRA adopted greater FX flexibility within a widening FX band regime and in July 2025 it adopted greater interest rate flexibility. The former required International Monetary Fund support (primarily to boost the BCRA's gross reserve position), while the latter required the development of a secondary market for liquidity between private financial entities (Graph 6).

The more flexible FX regime has helped the economy cushion the shocks from both external ("tariff wars") and domestic (election risk) sources of uncertainty, allowing for a depreciation of the real exchange rate – additionally reflecting the appreciation of our main trading partner with respect to USD.

In contrast, the impact of the BCRA's shift away from a passive sterilisation window (reverse repos) with a fixed policy interest rate to active sterilisation through open market operations (repos, simultáneas [2]) in an overnight market where interest rates are market-driven produced an initial sharp increase in the level and volatility of nominal and real interest rates. Political developments (election uncertainty) additionally contributed to the upswing and volatility of interest rates.

The BCRA's FX regime — Graph 6



Source: Central Bank of Argentina (BCRA).

Uncertainty affecting interest rate transmission channels: The BCRA's policy tools evolved during 2025, and liquidity management was carried out through two main channels: reserve requirements (RRs) were sharply raised and complemented

[2] "Operaciones Simultáneas"(Simultaneous Operations) are a trading modality in the Argentine financial market that allows, within a single transaction, the agreement of a purchase and a sale of the same instrument with different settlement terms, in an integrated manner and guaranteed by a central counterparty.

with sterilisation through open market operations (OMOs) in overnight markets using T-bills/repos rather than a standard window facility. Uncertainty was affected by disintermediation trends, and the BCRA responded with innovation and the adoption of complementary instruments to carry out liquidity operations with non-bank entities, like broker-dealers.

Uncertainty affecting the policy response (event risk) and the importance of the FX channel: The path of money demand was estimated, and the path of money supply was established, in correspondence to the most probable macroeconomic scenario envisioned by the BCRA in early 2025. However, the surfacing of tail-risk uncertainty (election) led to a significant deviation in the ex post policy response. The evolution of M2 traced a path significantly below two standard deviations from the baseline (Graph 5.C). That decline in money demand and the deviation of money supply from the baseline projections reflect the private sector's cash portfolio rebalancing towards USD and away from ARS.

The BCRA's efforts to sterilise pesos and therefore accommodate the sharp increase in demand for dollars exceeded adjustments to banks' RRs and OMOs that largely determine the observed level of M2. It also included supplying the market with hedging (USD futures contracts) and, when the currency hit the top of the FX band, selling USD reserves in the official spot market. Private sector demand for USD was further satisfied indirectly through Treasury auctions of USD-linked securities subscribed in ARS.

Implementation has therefore been challenging, but two recent developments are worth highlighting:

- **Interest rate and yields:** Money market interest rates and the yield curve were sharply but temporarily impacted by uncertainty. Subsequent action from both the central bank (in the money market) and the Treasury (in the bond market) have contributed to normalising the short-term funding interest rate and the yield curve slope.
- **Inflation expectations:** The significant monetary tightening ahead of the election in 2025 has resulted in very well anchored inflation expectations. Expectations in late 2023 on 2024 inflation were almost double the inflation ultimately observed in 2024 thanks to fiscal and monetary consolidation. Despite changes to refine the monetary targeting regime and elections, in 2025 Argentina delivered the lowest monthly inflation reading of the last five years (1.9% monthly in August). Importantly, inflation expectations (as measured by the BCRA survey of analysts' forecasts, REM) have remained well anchored. This achievement is very relevant for an economy that operates a bi-monetary regime and has adopted a more flexible FX regime. Current estimates of exchange rate pass-through to domestic prices are around a third of their late 2023 level.

5. Concluding remarks

Argentina's recent stabilisation programme and monetary regime transition make mapping and managing uncertainty much more challenging than is the case when monetary policy is tasked to manage uncertainty related to the business cycle. In our

case, identifying, distinguishing and measuring uncertainty within a new monetary framework has implied dealing with conventional uncertainty (in modelling: parameter robustness, regime switching and forecast errors in baseline macro scenarios). Beyond the latter, the materialisation of event risk has required a credible discretionary risk management response to rapidly unfolding developments. The BCRA's 2025 M2 targeting framework has offered a coherent response that pairs a nominal monetary anchor with a more flexible FX regime and multiple market liquidity tools. This framework has made it possible to consolidate progressive disinflation, with lower exchange rate pass-through and more anchored inflation expectations.

Monetary policy decision-making and communication under heightened uncertainty in Brazil

Diogo Abry Guillen and Leonardo Nogueira Ferreira[1]

Introduction

The effects of uncertainty on monetary policy decision-making and communication are pervasive. First, uncertainty poses significant challenges for the **conduct** of monetary policy. Given the multiple channels through which uncertainty can affect the economy (eg the "wait and see" approach (Leduc and Liu (2016)) and the cost of finance (Fernández-Villaverde et al (2011)), among many others) and the difficulty in assessing the dominant channels in real time, it can be prudent to act cautiously, allowing policymakers time to gather more evidence and expand their information set. This conservatism or gradualism is supported by many in the field, including Brainard (1967), Woodford (2003) and Bernanke (2004), among others. At the same time, however, monetary policy can benefit from guarding against risk scenarios and model uncertainty by adopting an approach that is robust to different outcomes. This may, at times, require a more vigorous response to shocks. Such a strategy is considered optimal in many settings, as shown by Giannoni (2002, 2007), Onatski and Stock (2002), Leitemo and Söderström (2008) and many others. The challenge for policymakers, then, is to strike a balance between these two approaches.

Second, uncertainty affects the **transmission** of monetary policy. Evidence for the United States and the euro area shows that uncertainty dampens the effects of monetary policy (Aastveit et al (2017), Falconio and Schumacher (2025)). Faced with high uncertainty, households and firms may prefer to postpone their consumption and investment decisions regardless of interest rate levels. This reduces their sensitivity to monetary policy. While this may prompt some central banks to act more aggressively in order to achieve the desired outcomes, some other policymakers may be tempted to refrain from adjusting monetary policy due to its reduced effectiveness. Ultimately, such decisions will be made on a case by case basis, but it is important not only to acknowledge that the transmission of monetary policy depends on the level of uncertainty but also to internalise it within models.

Finally, uncertainty adds complexity to **communication**. On the one hand, central bank communication is considered more important in times of heightened uncertainty as it can serve as a guide to help economic agents navigate turbulent conditions. On the other hand, communication becomes more difficult since the economic outlook and, therefore, the next steps are also less clear to the central bank. This is the trade-off central banks face: balancing information revelation with the risk of introducing noise. Compared with the previous points, there is limited empirical

[1] Diogo Abry Guillen: Deputy Governor, Central Bank of Brazil. Leonardo Nogueira Ferreira: Advisor, Economic Advisory to the Governor, Central Bank of Brazil.

evidence on where central bankers currently stand on this trade-off and on whether they should communicate more or less, as well as what the content of this communication should be.

In this chapter, we briefly discuss the Brazilian experience in dealing with uncertainty. We start with an analysis of different indices of uncertainty and how different they are over time. Not only do different measures provide different results, but, as we elaborate in the following section, in periods of high uncertainty monetary policy has a lower impact on some of the transmission mechanisms. In this analysis, we also elaborate on how the Central Bank of Brazil (BCB) acknowledges, captures and conveys uncertainty in various aspects of monetary policy decision-making and communication.

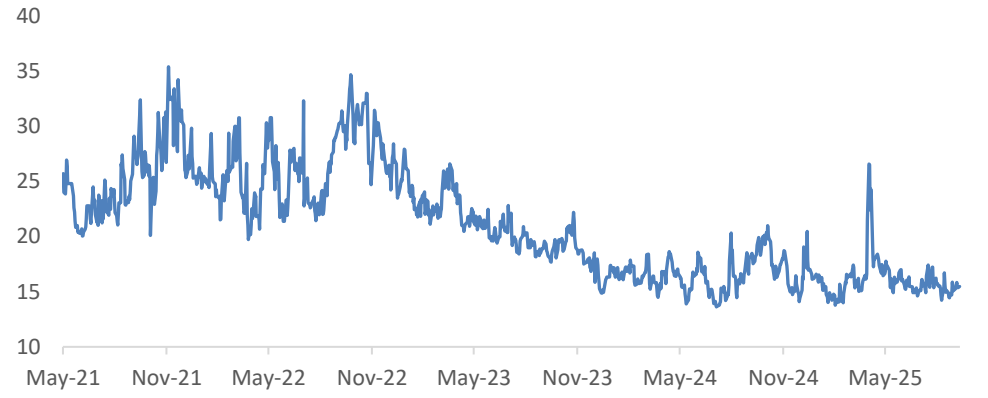
Acknowledging uncertainty

In this section, we examine various measures of uncertainty in Brazil, categorising them into market-based, news-based and econometric-based indices. We analyse each index individually and explore the cross-correlations among them. As highlighted by Ahir et al (2025), there remains considerable uncertainty about how uncertainty itself should be measured. Different indices capture distinct dimensions of uncertainty, which underscores the importance of monitoring a diverse set of indicators to gain a comprehensive understanding of economic sentiment and risk.

Market-based

The first measure is the S&P/B3 Ibovespa VIX (Graph 1). Like the US version, it measures the 30-day implied volatility in the stock market, reflecting investor sentiment about the expected volatility in the Brazilian benchmark equity index, the Bovespa index. What is different from the US VIX, however, is that it has been available for a very short span. According to this measure, uncertainty reached its highest level during the Covid-19 pandemic and, more recently, right after "Liberation Day" in April 2025.

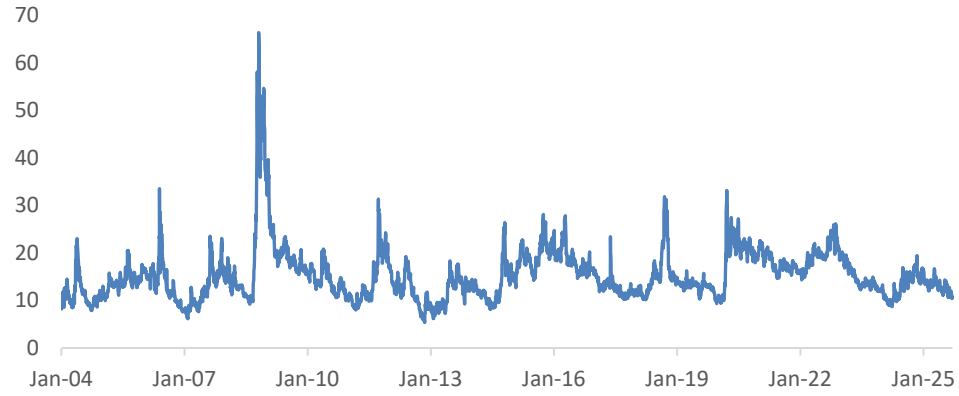
S&P/B3 Ibovespa VIX — Graph 1



This is why we also pay close attention to other market-based measures, for example, the implied volatility of the Brazilian real (relative to the US dollar), which is available for a longer period (Graph 2). According to this measure, uncertainty peaked in October 2008 during the Great Financial Crisis, and the outbreak of the Covid-19

pandemic was only the third highest level. Based on this measure, recent uncertainty has been significantly lower than in past historical episodes.

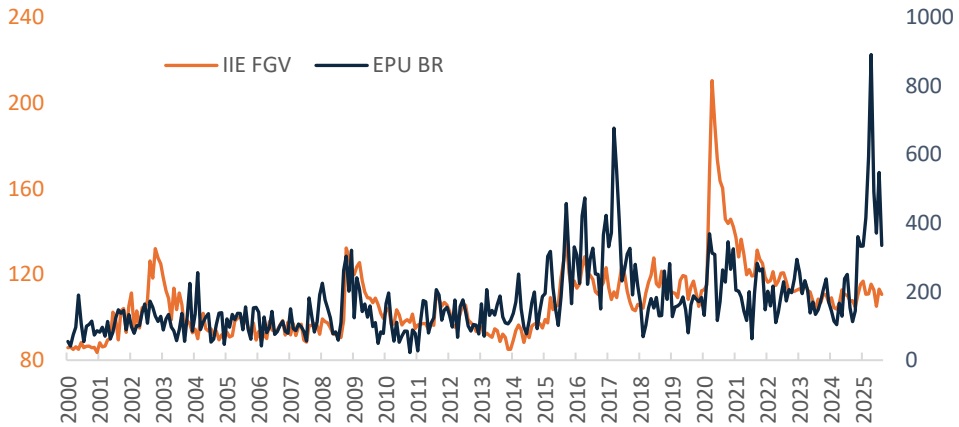
USDBRL one-month implied volatility ATM — Graph 2



News-based

In Brazil, there are also two news-based indices. The first is the Economic Policy Uncertainty (EPU) Index for Brazil, a text-based metric developed by Baker et al (2016) and replicated for Brazil. The authors count uncertainty terms in Folha de São Paulo from 1991 onwards. The second is the Economy Uncertainty Index (IIE-Br), which is constructed by Fundação Getúlio Vargas (FGV) and composed of two parts: (i) the media component, reflecting the incidence of terms related to uncertainty in articles published in six of Brazil's main newspapers, with a weight of 80%; and (ii) the expectation dispersion component, which is based on the dispersion of specialist forecasts for macroeconomic variables, with a weight of 20%.

News-based indices — Graph 3



Graph 3 shows that there are important differences in the behaviour of these series. They peak at different times, and the EPU for Brazil is much more volatile than the IIE-Br. The latter seems to better match the narrative account of the events throughout the years, whereas the EPU seems to overreact to some incidents. While informative in some respects, the adequacy of measures based on news counts as

proxies for uncertainty depends on how strongly they are correlated with this latent process as highlighted by Jurado et al (2015). Moreover, as Ahir et al (2025) point out, text-based measures can sometimes be excessive due to the intense media focus, diverging from the latent process they aim to capture.

Econometric-based

Such concerns about the use of news-based metrics to capture uncertainty led to the development of an alternative, econometric-based measure (Ferreira (2025)). This measure is constructed based on a large Bayesian vector autoregressive (BVAR) model with errors whose time-varying volatility is driven by a common unobservable component in line with Carriero et al (2018) and Chan (2020). The model is estimated with standard Bayesian methods, 12 lags and 16 publicly available monthly macroeconomic variables, starting in January 2003. The resulting common stochastic volatility (CSV) is the measure of uncertainty (Graph 4). Evidence for the United States (eg Carriero et al (2018), Alessandri and Mumtaz (2019)) shows that this measure tracks uncertainty effectively. Some well known episodes of high uncertainty coincide with spikes in the series, such as the Great Financial Crisis, periods of political instability and the Covid-19 pandemic.

Econometric-based measure of uncertainty (CSV) Graph 4

[1] To facilitate the comparison, the common stochastic volatility is rescaled so that its first year, 2004, has a mean of 100.

Uncertainty about uncertainty

These uncertainty measures can differ significantly during some periods, which is why it is important to track different measures as well as to understand why this may be so. This happens because they may be capturing different uncertainty drivers. Comprehending this is crucial to the conduct of monetary policy. VIX, IIE-BR and CSV always show pairwise correlation of 0.60 between them, while the EPU BR exhibits lower correlation with the other measures (Table 1).

Matrix of correlations Table 1

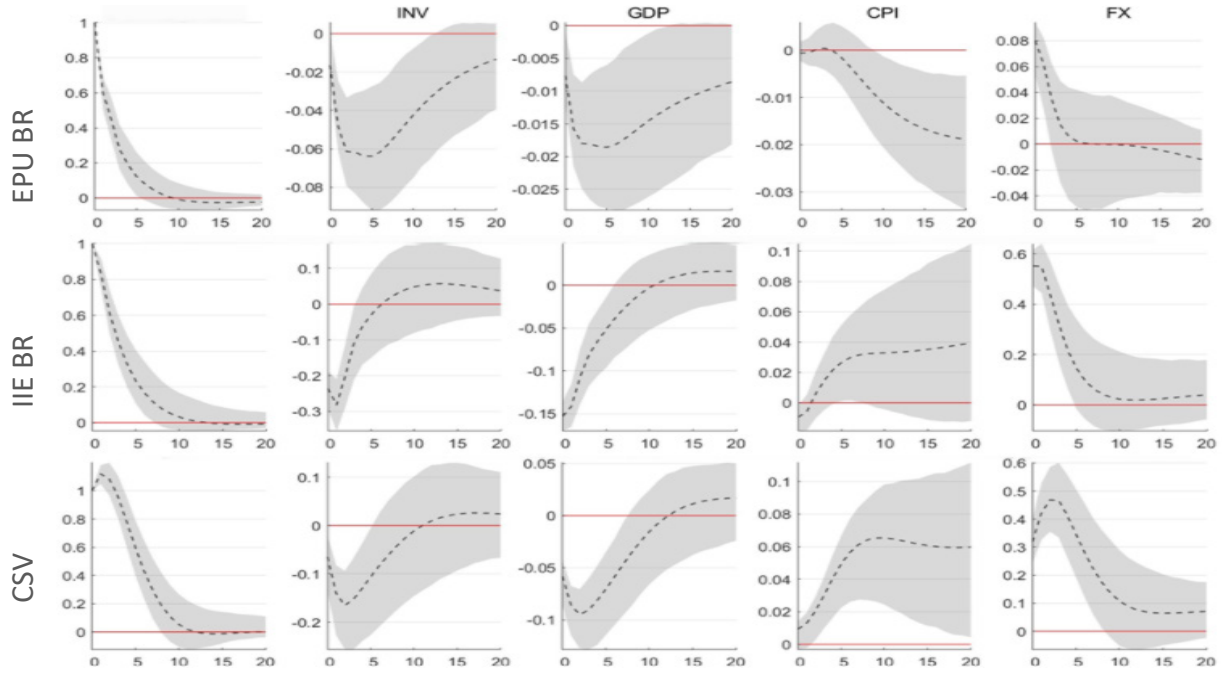
	VIX	FX Vol	IIE FGV	EPU BR	CSV
VIX	1	0.83	0.60	–0.24	0.66
FX Vol		1	0.53	0.26	0.53
IIE FGV			1	0.45	0.62
EPU BR				1	0.14
CSV					1

Most importantly, different measures of uncertainty lead to different impulse response functions (IRFs) for the CPI following a 1% uncertainty shock, as shown in Graph 5. Such IRFs are produced by a BVAR estimated with standard Minnesota NIW priors and prior tightness optimally set as in Ferreira et al (2025b) and Giannone et al (2015). The sample period starts in Q1 2004 and ends in Q2 2025, and estimation up to Q4 2019 produces similar results. Identification is recursive, with uncertainty ordered first.

The effects are similar when IIE BR or CSV are used, with uncertainty exerting an inflationary effect, consistent with firms' precautionary pricing behaviour (Fernández-Villaverde et al (2015), Mumtaz and Theodoridis (2015)). Nevertheless, in the BVAR with EPU BR, uncertainty has deflationary effects, acting as aggregate demand shocks (Leduc and Liu (2016), Basu and Bundick (2017)). The latter, however, should be interpreted with caution, as the peaks in the EPU BR time series around 2016–17 were followed by disinflation periods driven by other factors, which may be influencing the findings.[2]

[2] Interestingly, nothing particularly uncertain took place in M3 2017, the local maximum and the second global maximum of the time series.

Impulse response functions following a 1% uncertainty shock[1] Graph 5



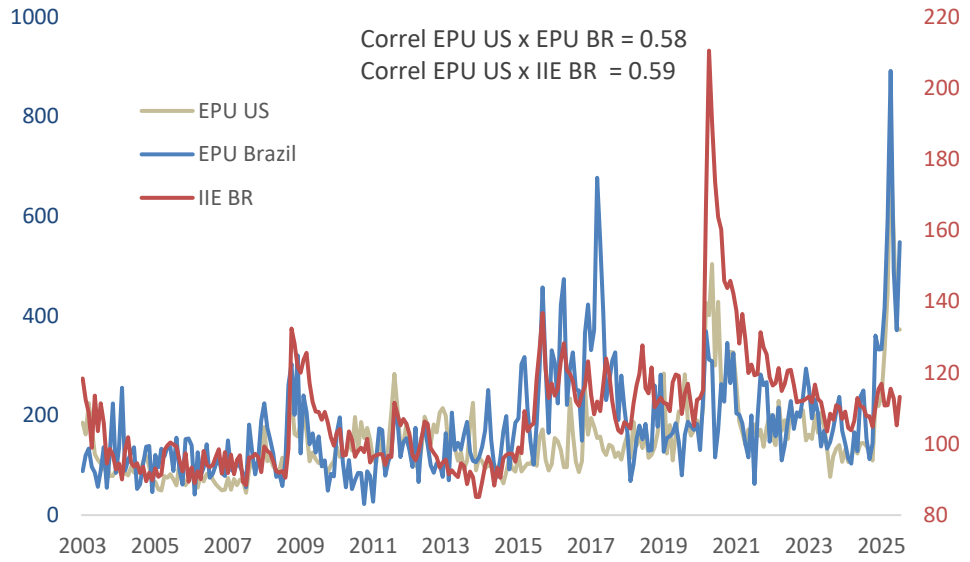
[1] The solid lines are the medians, while the shaded area represents the 68% error bands. Each row corresponds to a different measure.

Uncertainty across countries

Another feature worth highlighting is that, although uncertainty has recently reached historical highs in both advanced economies (AEs) and emerging market economies (EMEs), an analysis of previous years reveals an important difference between these two groups. While elevated uncertainty is a relatively recent phenomenon in the United States, Brazil's time series reveals multiple episodes of heightened uncertainty over the years (Graph 6). Consider the news-based EPU indices for Brazil and the United States and the IIE-BR. At times, the series co-move, suggesting an external source for the uncertainty in Brazil, such as global events like "Liberation Day".[3] At other times, however, the uncertainty in Brazil is driven by domestic factors, such as the period 2015–17, when political instability significantly affected the economy.

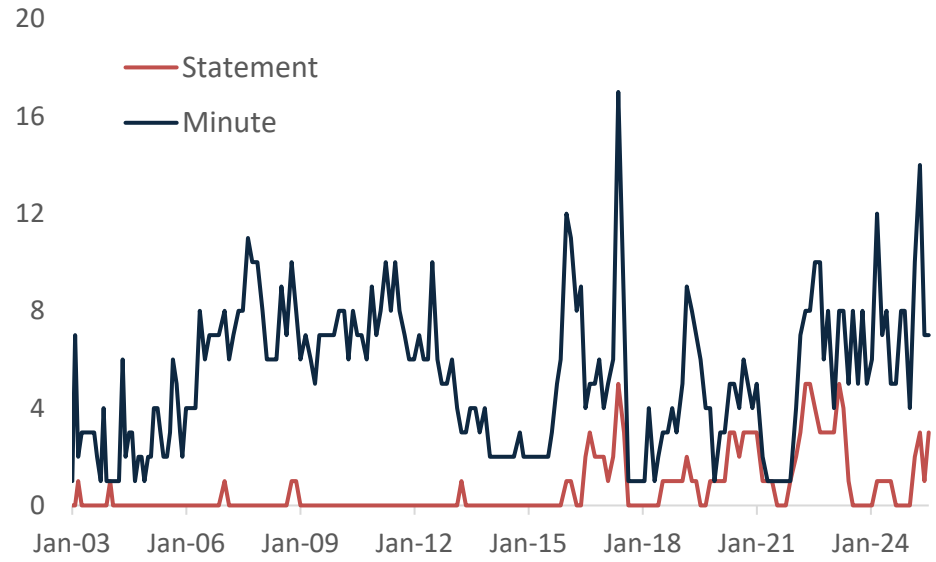
[3] Note, however, that this peak does not translate to IIE-BR with the same intensity, highlighting the importance of following alternative measures.

EPU for Brazil and the United States and IIE BR Graph 6



A natural corollary is that central banks in EMEs may be more accustomed to conducting policy under uncertain conditions. Indeed, Graph 7 shows the BCB has been acknowledging the presence of uncertainty in its official communication for some time. Appropriate tracking and acknowledgement of uncertainty are essential to incorporate it properly into the monetary policy framework.

Occurrence of the term "uncertainty" in the BCB's communication Graph 7



Incorporating and conveying uncertainty

In economic analysis

Since the Bernanke review of the Bank of England framework (Bernanke (2024)), much has been said and written about the importance of publishing alternative scenarios as a way to provide the public with information about the Monetary Policy Committee's policy reaction function and its views on the monetary transmission mechanism.

In times of high uncertainty, the complexity in the use of alternative scenarios increases even further. Not only are many scenarios possible, reducing the added value of each, but economic conditions may suddenly change, making these scenarios outdated in a matter of weeks or even days. This could generate the unintended result of compounding uncertainty. In fact, when messages become too complex, agents tend to oversimplify them, often resulting in an inaccurate interpretation (Blinder (2018)). Simplicity plays a key role in anchoring expectations. Simplicity regarding the framework with a clear mandate at every point in time helps with anchoring expectations and allowing the policy reaction to be more predictable.

In the case of Brazil, the central bank has usually emphasised the uncertainty around the reference scenario, even though it has provided alternative scenario forecasts during some periods. Coupled with the reference scenario, the BCB's Monetary Policy Committee publishes the balance of risks. There are basically two sources of risks considered. The first is related to the use, in the reference scenario, of conditioning assumptions based on the established governance, as is the case of the Selic rate, exchange rate, and oil price trajectories, which do not necessarily reflect the most likely scenario assessed by the Committee. The second stems from the assessment of the possibility of materialisation of certain events and their impacts on inflation, not considered as the most likely when building the reference scenario.

In the reaction function

As in advanced economies, heightened uncertainty reduces the sensitivity of the Brazilian economy to monetary policy. We formally assess this heterogeneity by estimating a threshold VAR (TVAR) model defined as:

$$Y_t = c_1 + \sum_{j=1}^{4} \beta_{1,j} Y_{t-j} + \mu_t, Var(\mu_t) = \Omega_1 \; if \; S_t \leq \; Y^*$$

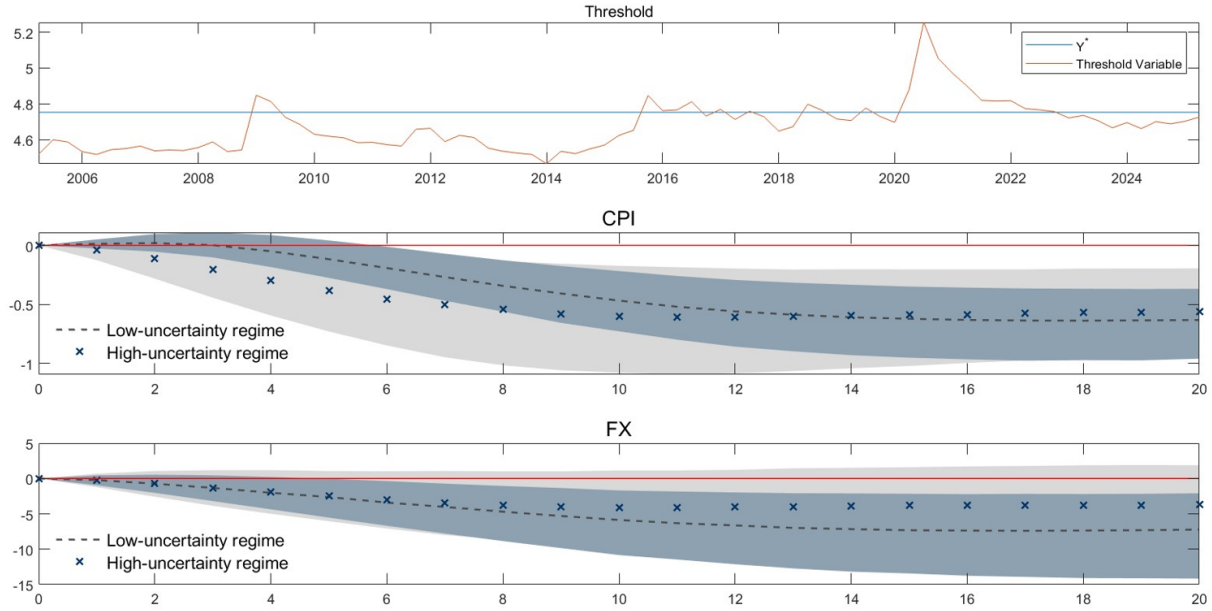
$$Y_t = c_2 + \sum_{j=1}^{4} \beta_{2,j} Y_{t-j} + \mu_t, Var(\mu_t) = \Omega_2 \; if \; S_t > \; Y^*$$

where Y_t is a matrix of five endogenous variables (uncertainty, GDP growth, CPI inflation, the exchange rate and the policy rate), $S_t = Y_{t-1,1}$ (ie the first lag of uncertainty) is the threshold variable and Y^* is the threshold level. The model is quarterly and estimated with a Gibbs sampling algorithm with a Metropolis-Hastings step to sample Y^*. The sample period starts in Q1 2004 and ends in Q2 2025. The monetary policy shock is identified recursively, with the policy rate ordered last.

Graph 8 presents the estimated threshold and the impulse response functions of the levels of CPI and the exchange rate to a 100 basis point monetary policy shock. The top panel plots the log of IIE-BR alongside the estimated threshold. The periods in which uncertainty exceeds the threshold, indicating a high-uncertainty regime, are consistent with the narrative evidence: the Great Financial Crisis, the 2015–16 political and economic crisis, and the Covid-19 pandemic.

The two bottom panels show the impulse response functions. Responses are weaker in terms of both the median estimates and the probability mass. This difference is particularly relevant for the exchange rate. In normal times, a 100 bp hike leads to a median BRL appreciation of 7.2%. However, during periods of elevated uncertainty, the effect is not statistically significant in the high posterior density (HPD) sense. Among other channels, this attenuation occurs because heightened uncertainty hampers capital inflows, reducing or even muting the impact of monetary tightening on the exchange rate. Such features must be taken into account in the conduct of monetary policy.

TVAR impulse response functions following a 100 basis point monetary policy shock[1] Graph 8



[1] Shaded areas denote 68% posterior coverage bands. The dashed line and the blue area represent the low-uncertainty regime. The line with cross markers and the grey area represent the high-uncertainty regime.

In fact, since EMEs are typically subject to larger and more frequent shocks and regimes may change more often, conducting monetary policy requires even greater caution and flexibility. Nevertheless, this approach must be balanced with the need to sometimes react more strongly to avoid inflationary risks and the de-anchoring of expectations. In fact, given their history of high inflation, some central banks in EMEs tend to respond more aggressively to inflationary pressures (Hofmann and Bogdanova (2012)).

The experience at the BCB has been marked by a careful balance between these two approaches. Several episodes in recent years provide examples of their application. In 2016–17, for instance, amid an uncertain disinflation process, the BCB initially eased policy cautiously and only accelerated rate cuts once it became clearer that inflation was on a firm downward path. In 2021, however, the strategy was different. As Brazil's economy recovered from the pandemic, inflation started to accelerate and the BCB faced uncertainty regarding the nature of the shock: temporary vs persistent. Nonetheless, the risk that inflation expectations could de-

anchor led the BCB to act pre-emptively and "front-load" aggressive interest rate hikes, raising the policy rate from 2% to above 7% within months.

In communication

Communication has become a central piece of monetary policy. Statements have become longer, minutes more analytical, speeches more frequent and, as predicted by Blinder (2018), transparency about monetary policy has increased over time. In practice, however, it is not entirely clear how much a committee should communicate, or what the content of this communication should be. Sharing views on the outlook and signalling future steps are important parts of modern monetary policy but can introduce noise.

In uncertain times, striking this delicate balance becomes even more challenging.[4] On the one hand, the more uncertain the outlook, the more guidance agents expect from the central bank. On the other hand, it is precisely during such periods that communication becomes more difficult, as the economic outlook and, therefore, the next steps are also less clear to the central bank. However, being transparent is important to coordinate expectations and also for accountability.

This is why the BCB has communicated that it may refrain from offering guidance in periods of heightened uncertainty, but that it should be transparent about the reaction function. Central bank models as well as their updates have also been published in the *Monetary Policy Report*.[5] By disclosing the framework that ensures that the decision-making process is conducted in a systematic and coherent way, the BCB adheres to best international practices in central banking and is continuously improving, and enhancing its credibility, especially in times of high uncertainty.

Conclusion

Uncertainty permeates every stage of monetary policy – from decision-making and transmission to communication. Acknowledging, measuring and transparently conveying uncertainty are essential for effective policy, especially in emerging markets where shocks are frequent and expectations can be fragile.

It is crucial that monetary policy does not become an additional source of uncertainty, and central bank communication plays a big part in achieving this. Clear, consistent and well calibrated communication helps anchor expectations, reduce noise and maintain the credibility of the monetary authority. At the same time, excessive or poorly targeted communication can inadvertently amplify uncertainty, especially when the outlook is already clouded.

Ultimately, the challenge for policymakers is to strike a careful balance: to act with both caution and flexibility, to be transparent without overcommitting, and to provide guidance without creating confusion. As the global and domestic

[4] In related work, we have found that more communication of the Federal Reserve during high-uncertainty periods does not improve forecasts relative to a purely macro Bayesian direct forecast (Ferreira et al. (2025a)).

[5] See "Updating of small-scale semi-structural models" in the June 2024 *Inflation Report* and "Updating the model for the medium-term projection of administered prices" in the June 2025 *Monetary Policy Report* as two examples. The *Monetary Policy Report* replaced the *Inflation Report* in 2025.

environment continues to evolve, this commitment to clarity and credibility will remain at the heart of effective monetary policy.

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From models to communications: strengthening risk management in monetary policy at the Bank of Canada[1]

Gino Cateau, Don Coletti and Annie Portelance[2]

1. Introduction

The Bank of Canada has a long tradition of developing and applying economic models to inform monetary policy. This practice began in the 1960s and has steadily evolved, shaped by new insights and emerging frameworks.

Most recently, as outlined in Coletti (2023), the Bank has embarked on building its fourth-generation projection and policy analysis models. This initiative is anchored by two priorities: first, the development of a new Canadian workhorse model that provides a richer modelling of the supply side and a deeper inflation narrative; second, a heightened focus on understanding and managing the risks and uncertainties that shape the economic outlook and guide policy decisions.

The overarching goal is to embed risk identification, scenario analysis and the consideration of uncertainty more systematically into both the Bank's modelling and policy processes. By doing so, the Bank aims to build a more resilient foundation for decision-making in a constantly changing environment.

Risk management recognises that monetary policy is inherently shaped by uncertainty (Kozicki and Vardy (2017), Poloz (2020), Macklem (2020)). Policymakers must identify key risks and uncertainties, weigh the consequences of policy missteps, and choose a course that balances those risks and uncertainties. The Bank has long viewed monetary policy as risk management rather than precision engineering (Poloz (2013)). Staff routinely present risk scenarios alongside the base case projection, layering expert judgment to explore how the outlook could shift. These scenarios help inform policy discussions.

However, in times of extreme uncertainty – also known as Knightian or radical uncertainty – the Bank fundamentally shifts its approach. The importance for the economic outlook of conditioning assumptions related to the source of uncertainty is emphasised. Rather than relying on a single base case and its associated risks, the Bank often considers a range of possible scenarios to help illustrate the high degree of unpredictability in the economic environment.

[1] Thanks to Sharon Kozicki, Stephen Murchison, and the panellists at the September 2025 Bank of Canada Next Generation Modelling Workshop – Nicoletta Batini, James Bullard, Doug Laxton and Silvana Tenreyro – for valuable discussions.

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Although the Bank's policy framework incorporates risk management, recent advances in modelling provide opportunities to introduce greater structure and systematically assess the implications of uncertainty.

2. Current practice: structure and process

Standard practice

The Bank's standard risk assessment process begins with staff preparing a base case economic projection, typically interpreted as the mean and mode of the forecast distribution. Judgment is then layered on to account for factors the model might miss and to balance risks around the projection.

Staff then present and discuss several risks, focusing mainly on shock uncertainty. These risks are run through a linear (or linearised) workhorse model. At meetings with the Bank's Governing Council, staff not involved in preparing the base case and risk scenarios weigh in on the balance of risks, and the relevance of the scenarios.

Policy discussions are anchored by the interest rate path consistent with the mean inflation outlook, derived from an estimated Taylor-type rule that is embedded in the projection model.

Adapting to Knightian uncertainty

As noted earlier, the approach changes in periods of radical or Knightian uncertainty. For example, during the pandemic – when it was impossible to predict the evolution of the virus or public health measures – the Bank used scenarios built on different assumptions to illustrate a spectrum of possible economic recoveries, rather than a single forecast (Bank of Canada (2020)). More recently, facing uncertainty about US trade policy, scenario analysis has helped gauge the potential economic impacts and the trade-offs monetary policy might face (Bank of Canada (2025a,b), Macklem (2025)).

3. Limitations and challenges in current practices

While the current approach has served the Bank well, three key areas for improvement have emerged:

3.1 Achieving a better balance between base case and risk analysis

Currently, there is considerable emphasis on developing and fine-tuning the base case projection. While base case projections are easy to communicate, they can create a false sense of precision and security. Even with frontier models and expert judgment, large and persistent forecast errors can occur. Internally, this focus on the base case can undermine risk-sensitive thinking; externally, it can tie the Bank's credibility too closely to its forecasting ability. For example, the sharp rise in inflation in the post-pandemic period exposed limitations in the workhorse model and

resulted in persistent forecast errors. Overemphasising the base case in uncertain times can end up weighing on central bank credibility.

3.2 Being more modest about models

Another area for improvement is fostering greater modesty about models and their assumptions. Economic models are indispensable tools for policy analysis, but they are built on simplifications and may not fully capture the complexities of the economy – especially during periods of rapid change or unexpected shocks (Gosselin and Kozicki (2023)). When preparing policy advice, it is essential to routinely question the assumptions underlying the existing models and to recognise that their predictions are only one perspective among many.

By adopting a more humble and critical approach to model use, policymakers can avoid overconfidence in any single framework and remain open to alternative interpretations of economic developments. This mindset encourages staff to challenge model outputs, supplement them with expert judgment, and clearly communicate the conditional nature of policy recommendations. Ultimately, integrating model uncertainty into the Bank's narratives helps ensure that policy advice is robust, transparent and better suited to navigating uncertainty.

Recognising the limitations of models is a necessary foundation for effective risk management. However, humility alone is not enough. To fully address the challenges of uncertainty, it is also important to broaden the scope of risk analysis – actively seeking out and evaluating a wider range of plausible scenarios that may fall outside the boundaries of the standard models in use.

3.3 Expanding risk analysis to include more plausible scenarios

A related but distinct area for improvement involves broadening the scope and imagination of risk analysis. Traditionally, risk scenarios have been developed primarily through the lens of the baseline model, which can constrain the range of possibilities and limit the effectiveness of policy responses. For instance, after the pandemic, many risk scenarios focused narrowly on how quickly inflation surprises would fade, rather than exploring alternative models or mechanisms that might explain the baseline model misses and drive inflation. As a result, the baseline model often suggested no major policy response was needed, even in the face of significant uncertainty.

However, there have been positive steps towards more imaginative scenario analysis. Notably, in the July 2022 *Monetary Policy Report*, the Bank explicitly analysed the risk of a wage-price spiral – a scenario in which rising wages and prices reinforce each other, threatening persistent inflation. This analysis moved beyond the workhorse model to consider a disruptive risk that could significantly alter the inflation outlook. By incorporating such alternative scenarios, policymakers are better equipped to anticipate and prepare for a wider range of plausible outcomes, strengthening the Bank's ability to respond effectively to uncertainty.

4. Advancing risk management: new tools and approaches

Effective risk management requires identifying the most important risks and uncertainties, understanding the consequences of policy errors, and choosing actions that strike the right balance. To support this, Bank staff are building a suite of models for the Canadian economy.

The suite will feature variants of the workhorse model, each designed to explore a single change in the key assumptions. Initial variants will challenge the behavioural foundations of inflation dynamics – exploring alternative approaches to price-setting (eg Harding et al (2022, 2023), Gasteiger and Grimaud (2023)) and the formation of inflation expectations (eg Gabaix (2020), Beaudry et al (2022)) – areas where the workhorse model may be overly simplistic.[3] Many variants incorporate non-linearities, such as non-linear Phillips curves, which can push the economy into costly "dark corners" (Blanchard (2014)). For example, persistent inflation surprises may cause expectations to become extrapolative, risking de-anchoring (Hommes and Lustenhouwer (2019), Kostyshyna et al (2024), Ozden (2025)). Other variants will examine different representations of the supply side, including the labour market and production networks.

Beyond this, the suite will also include models with different economic structures. These might focus on the interplay between monetary policy, financial vulnerabilities and the real economy or on uncertainties tied to climate change.

With this improved toolkit, staff are exploring several ideas to make risk assessment more systematic and more central to policy decisions:

- **Spending less time fine-tuning the base case.** Focusing the narrative on the major macro forces driving inflation and the economy – a "thick-line macro" approach. Time spent perfecting details with little impact on policy could be better used for deeper risk analysis.
- **Richer alternative scenarios** (Bernanke (2024), recommendation 7). By reallocating time from base case fine-tuning, staff can use the suite of models to develop richer alternative scenarios, addressing uncertainty about how the economy works and how inflation might evolve.
- **Shifting towards a baseline outlook that is more *mode* than *mean*.** Balancing multiple risks in the base case can be complicated, especially when important non-linearities and skewed risks are involved. Focusing on the most likely scenario – the mode – and exploring risks through alternative scenarios (including those based on alternative models) can keep projections transparent and narratives coherent.
- **Integrating scenario-based insights into policy recommendations in a disciplined, transparent way.** This means going beyond judgment alone. Staff are exploring new approaches to objectively weigh scenarios and assess whether the risks considered truly span the possible outcomes. Recent research offers promising techniques, such as the ideas of Deák et al (2025) for assigning weights to the forecasts from alternative models, and Adrian et al (2025) using Bayesian

[3] Adding additional complexity has its own costs. For example, while models with state-dependent pricing offer important realism, they are more difficult to estimate, take longer to simulate and can be challenging to operate in a fast-paced policy-setting environment.

decision theory to weigh scenarios and check coverage against a reference statistical forecasting model.[4]

Ultimately, the goal is to map insights from different scenarios – and their likelihood – into policy decisions. In exceptional times, where uncertainty is radical and probabilities cannot be assigned, the objective is to avoid the worst outcomes without imposing heavy costs in the less dire scenarios (see Brock et al (2003) and Kuester and Wieland (2010)).

5. Communication and public trust

The Bank's evolving approach to risk management is shaping how it works internally but also placing new demands on external communications, as greater emphasis on uncertainty adds complexity to messaging.

Communicating uncertainty creates a natural tension between two responsibilities: maintaining the Bank's credibility in anticipating and influencing economic outcomes and being transparent about what it doesn't know. Uncertainty itself can have disparate implications for policy: sometimes it calls for caution, but if the risk of inaction is high, it might require bold action even when evidence is incomplete (Wilkins (2017), Mendes et al (2017)). In any case, it is essential to convey that the inflation outlook is fraught with risks and will be updated as new information emerges, while reassuring the public that this does not constrain the Bank's ability to act decisively.

This tension between providing transparency and upholding public confidence in the Bank is particularly acute in periods of heightened uncertainty. The public looks to central banks for reassurance, yet it is precisely at these moments that acknowledging the limitations of models and explaining the conditionality of projections becomes most important.

Reassurance can be provided by affirming the Bank's commitment to delivering price stability and explaining how policy decisions are working to achieve it. The Bank must also position itself as a source of clear, transparent and objective information about evolving circumstances. Scenarios can be a valuable tool for illustrating uncertainty without undermining credibility. They can be used to explain how the economic outlook could change under different assumptions for a key unknown parameter (eg a tariff rate) or to illustrate how a shock could propagate through the economy (eg an OPEC announcement of increased oil supply). Using scenarios can be effective in public communications when accompanied by efforts to explain the approach to their development and analysis. The Bank has been providing extensive support to the media with briefings and access to experts to ensure accurate interpretation and reporting to the public.

[4] The reference statistical model is important because workhorse macro models often rely on simplifying assumptions, such as linearity and normally distributed shocks. These assumptions make the models tractable and easier to communicate, but they often result in underestimating the range of possible outcomes, especially during periods of economic stress or rapid change (see case studies in Adrian et al (2025)).

There is an inherent trade-off between clarity and comprehensiveness in monetary policy communications, particularly if communications are delivered in a "one-size-fits-all" format. Whereas expert audiences appreciate the subtleties in complex analysis and value conditional statements, providing intricate details in communications to the public can lead to confusion and misinterpretation.

This trade-off is increasingly difficult when the policy environment grows more complex, such as in situations of heightened uncertainty. Investing in a layered communications approach – where the depth of information is tailored to the audience's level of sophistication – can help achieve balance, provided that critical nuances are not inadvertently lost in the process.

Maintaining a coherent narrative throughout episodes of high uncertainty is also essential, as consistent communications build trust and credibility. The narrative should be anchored by key reference points while messaging on key themes evolves with developments. In recent periods of uncertainty, the Bank has achieved this by repeatedly emphasising its commitment to price stability, listing the variables it monitored to assess the outlook, and describing how they evolved over time.

The introduction of the Bank's new macroeconomic policy model is not only a technical milestone but also a communications opportunity. The new model will increase the types of scenario analyses that can be examined, enhancing the Bank's ability to take a risk management approach to monetary policy decisions. To help the public better understand the risks being weighed by the Bank, risk scenarios could be presented in its *Monetary Policy Report*, the primary vehicle for communicating base case projections and risks to the outlook. A richer risk discussion by the Governing Council would also be repeated in the summaries of deliberations.

Done well, this approach can strengthen the credibility of the Bank's work and reinforce trust by demonstrating its commitment to informed decision-making. Yet, communicating complex analyses clearly and effectively and aligning public interpretation with institutional intent will remain a challenging endeavour.

6. Conclusion

The Bank of Canada's journey in risk management and economic modelling reflects a continuous commitment to strengthening the foundations of monetary policy in an uncertain world. As the global economic environment grows more complex and unpredictable, the Bank's evolving approach – anchored in richer models, systematic scenario analysis and a heightened focus on uncertainty – positions it to respond with greater resilience and adaptability.

This chapter has highlighted three key areas for improvement: (i) achieving a better balance between base case projections and risk analysis; (ii) further integrating uncertainty about how the economy functions into economic narratives; and (iii) expanding the scope of risk analysis to encompass a wider range of plausible scenarios. Addressing these challenges is essential not only for robust policy formulation but also for maintaining public trust and credibility.

The development of a suite of models, the adoption of innovative scenario-based techniques and a renewed emphasis on transparent communication all serve to embed risk management more deeply into the Bank's policy process. By systematically weighing risks and uncertainties – and clearly conveying these

considerations to the public – the Bank aims to make monetary policy both more effective and more understandable.

Ultimately, the Bank of Canada's experience underscores the importance of embracing uncertainty, fostering intellectual humility and remaining open to new approaches. As central banks around the world confront similar challenges, ongoing dialogue and shared learning will be vital for advancing the practice of risk management in monetary policy.

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Uncertainty and monetary policy: the case of the Central Bank of Colombia

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1. Introduction

Apart from the Great Financial Crisis and a politically motivated closure of the Venezuelan market in 2008 and 2009, the Colombian economy went through a period of relative macroeconomic stability between 2004 and 2015. This period came to an end with the conclusion of the commodity super-cycle in 2014–15. The fallout of this shift included a loss of income and an increase in public debt. The latter implied greater vulnerability and a diminished ability to withstand new shocks. In this context, the pandemic came and, afterwards, a succession of domestic and foreign inflationary shocks, an even higher public debt ratio and heightened economic policy uncertainty significantly complicated the job of the central bank – to drive inflation back to target at a low cost in terms of economic activity.

Thus, the environment in which monetary policy operates has shifted markedly over the past five years. The series of unexpected supply shocks has made it difficult to produce and communicate a macroeconomic forecast, strengthening the case against the use of forward guidance. It has also forced the repeated postponement of convergence of inflation to target, with possible consequences for monetary policy credibility. At the same time, greater economic policy uncertainty and an increasingly complex fiscal outlook have pushed up the sovereign risk premium, long-term interest rates and the neutral interest rate.

The highly uncertain environment may have also changed some transmission mechanisms of monetary policy in substantial ways. For example, a loss of monetary policy credibility after the succession of inflationary shocks may have increased the incidence of indexation and thus the importance of past inflation in price formation. Likewise, Osorio (2025) shows that economic policy uncertainty has risen in the past decade, especially after the pandemic, and finds a negative effect of greater uncertainty on the demand and credit channels of monetary policy.[2]

This note outlines how the Central Bank of Colombia has addressed uncertainty in its monetary policy over the past five years. It first presents a brief review of the monetary policy framework and the performance of the Colombian economy. This is followed by a discussion of the types of uncertainty that are typically included in monetary policy analysis in Colombia and of the influence of uncertainty in monetary

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[2] Falconio and Schumacher (2025) also observed a negative effect of economic uncertainty on the influence of monetary policy shocks on inflation and unemployment in the euro area.

policy decisions. Finally, the note describes the main features and some challenges involved in the central bank's communication of uncertainty.

2. The current monetary policy framework in Colombia

Monetary policy in Colombia has followed a fully fledged inflation targeting strategy since 1999. This scheme was successful in driving down inflation from about 10% to the 3% long-term target in 2009, and in maintaining it around target up until the post-pandemic inflationary episodes.

In 2019, the framework was enhanced to deepen the macroeconomic analysis and make policy decisions more robust. Specifically, the forecast rounds were expanded to include more analysis of the data and discussion among the staff and between the staff and Board members. New techniques and refined medium-term forecast models were introduced as well. These changes required the central bank to increase the length and scope of forecast rounds and, consequently, reduce the number of policy interest rate setting Board meetings from 12 in a year to eight.

Today there are four yearly forecast rounds, each including two monthly policy setting Board meetings. In each round, a detailed analysis of new internal and external data is presented to Board members. Then a GDP "nowcast" and short-term forecasts for inflation are prepared and presented to Board members. Next, based on these inputs and on the identification of the macro shocks embedded in them, general equilibrium models are used to produce a central ("modal") medium-term forecast, alternative risk scenarios and "predictive density functions" (measures of uncertainty) for the most important exogenous and endogenous macro variables. Finally, a monetary policy report (MPR) and the staff´s policy recommendation are written and presented to the Board. All along this process, there are several meetings in which Board members interact with the staff, so that the latter may address the former´s comments and concerns. Nevertheless, both the forecast and MPR are the staff´s.

After each monetary policy setting Board meeting, a press statement is released and a press conference is held in which the decision and the main factors behind it are explained to the public. Three working days later, the minutes of the Board meeting are published. They include a brief summary of the most important data considered in the decision, a recap of the main issues on which all Board members agree and a section in which they explain their differences (without identifying individual positions). Four times a year, this is accompanied by the publication and presentation of the MPR by the staff, including the main elements of the forecast and the key risks around it.

Neither the forecast path of interest rates nor the staff´s policy recommendation is published. Since the forecast stems from the staff´s assumptions and assessments, the interest rate path does not necessarily reflect the collective or individual views of the Board. Hence, its publication may complicate the communication of the policy decision and the forecast. For most audiences, the distinction between the Board and the staff of the central bank is blurry. In this context, explaining differences between a published path and policy decisions, or changes in a published path, may prove cumbersome. For the most sophisticated audience (market analysts), the MPR provides a qualitative comparison between the forecast interest rate path and the

median of a central bank survey among analysts. Namely, the MPR indicates whether the forecast interest rate path is, on average, above or below the median of the survey responses. The staff´s policy recommendation is not published, in order to keep communication between the Board and the staff frank and open, without any hindrance from outside.

3. The performance of the Colombian economy in the past five years: a slew of large shocks

Since the pandemic, monetary policy has been made in an environment of heightened uncertainty. During the pandemic, uncertainty was particularly of the "Knightian" type, because of the shock itself and the extraordinary public policy responses that affected the transmission mechanisms and distorted some traditional indicators (eg core inflation and rents).

The pandemic has been followed by a succession of large and sometimes persistent external and domestic shocks. The disruption of global supply chains, increased costs of international trade and Russia´s invasion of Ukraine were relevant external shocks that influenced monetary policy everywhere. In Colombia, internal shocks were perhaps as important as, or even more important than, the external ones.

A serious social unrest episode in 2021 had large effects on the risk premium, the exchange rate and food supply. The "La Niña" and "El Niño" phenomena also disturbed the food and (hydroelectric) energy supply. Political risk and fiscal deterioration raised risk premia and prompted a currency depreciation in 2021 and 2022. These shocks hit an economy characterised by strong demand, following the pandemic-related macro policy stimuli and a significant expansion of the domestic loan supply. Afterwards, a large correction of heavily subsidised fuel prices in 2023 and remarkably high increases of the minimum wage in the past four years have had substantial effects on local prices.

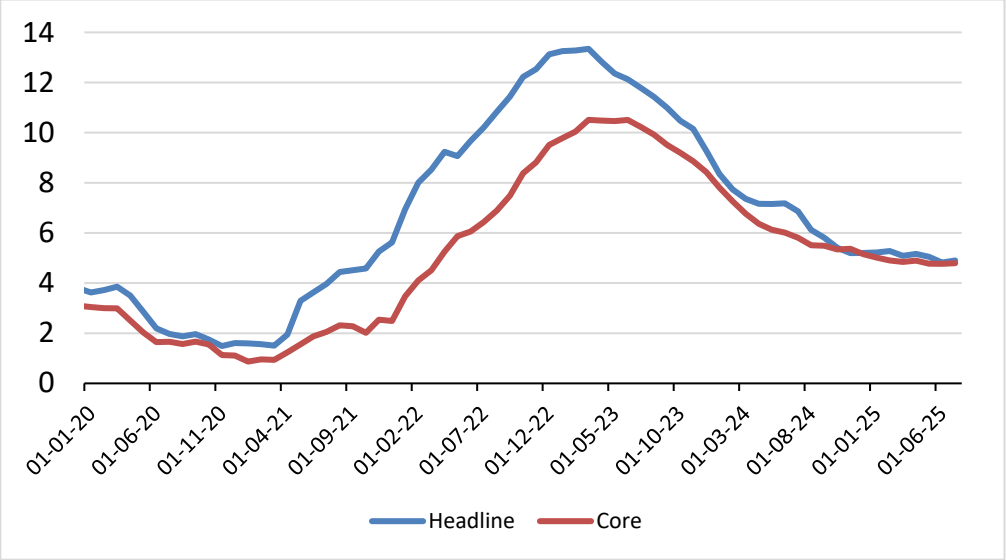
As a result, there have been large and persistent inflation deviations from target in the past four years (Graph 1). Consequently, the central bank has faced serious difficulties with bringing inflation back to target without heavy losses in economic activity and has had to deal with a deterioration of the credibility of the inflation target, possibly increasing the degree to which prices are indexed to past inflation.

To bring inflation back to the 3% target, monetary policy has been **contractionary since mid-2022** (Graph 2). Inflation has fallen since the second quarter of 2023, after the effects of the shocks vanished and as a result of tight policy. The excess demand and large current account deficit observed in 2022 (6% of GDP) were corrected in 2023 (Graph 3). In 2025, convergence of inflation to target has slowed down and growth has gradually recovered, requiring a continued contractionary stance of monetary policy.

The succession of unanticipated large shocks has made it difficult to credibly communicate a time of convergence to target and may have reduced the credibility of the announcements in that regard. Hence, dealing with and communicating uncertainty have proven very difficult challenges for monetary policy in Colombia in the past five years.

Headline and core CPI inflation

Graph 1

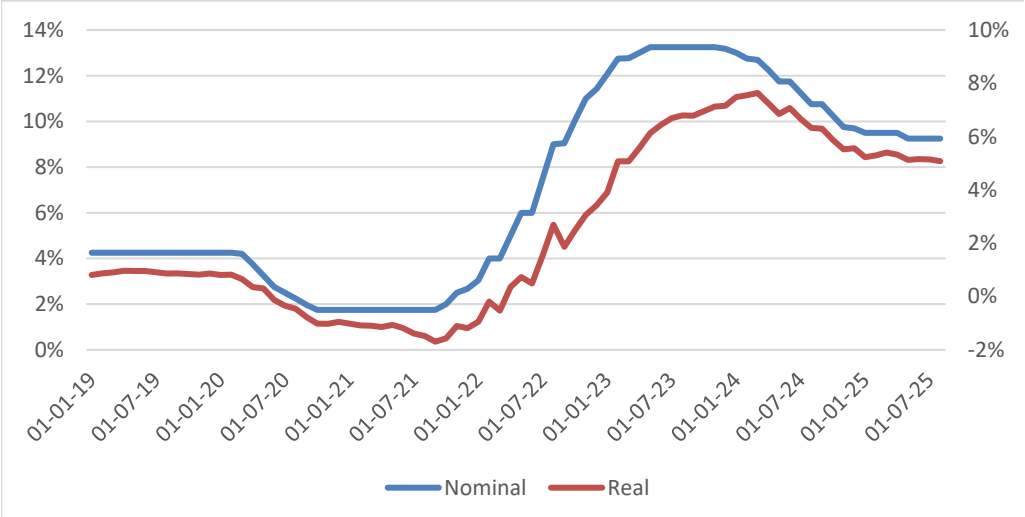


Core inflation excludes food and regulated prices.

Sources: Central Bank of Colombia; DANE.

Nominal and real ex ante monetary policy interest rate

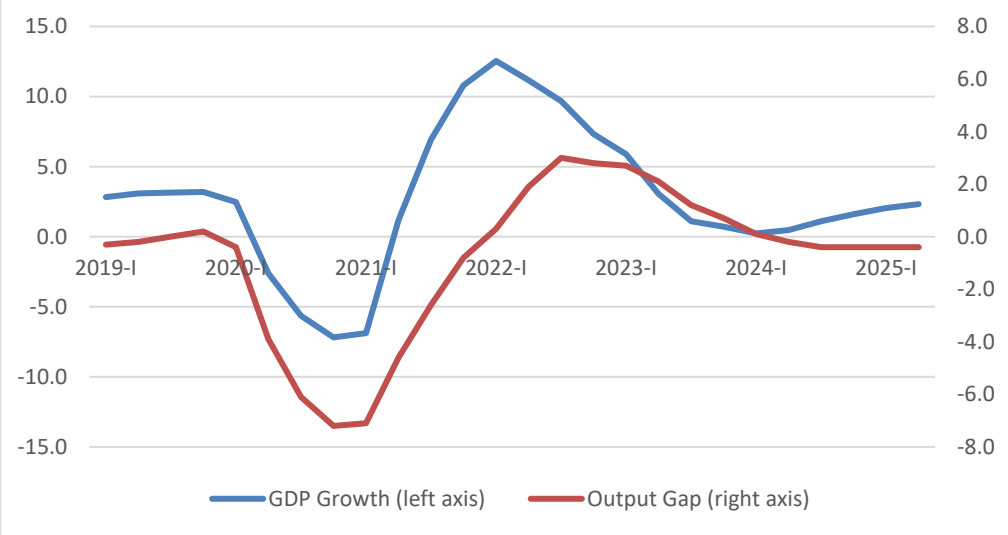
Graph 2



The real ex ante policy rate is calculated with one-year-ahead inflation expectations from the central bank's monthly experts survey.

Source: Central Bank of Colombia.

12-month GDP growth and output gap Graph 3



Both the 12-month GDP growth rate and the output gap are calculated based on GDP series adjusted for seasonality and calendar effects.

Sources: Central Bank of Colombia; DANE.

4. Types of uncertainty and their treatment in monetary policy analysis

The typical monetary policy analysis at the Central Bank of Colombia takes into account uncertainty on the nature and duration of observed or expected shocks, as well as on the transmission channels of monetary policy (as reflected in the specification and parameters of the general equilibrium models used for forecast and policy simulation). Unknown unknowns are not usually considered in the analysis; the Covid-19 episode was a notable exception (Box 1).

Relevant sources of uncertainty are incorporated in the assessment of monetary policy through an explicit list of "key judgments" used to build the central forecast scenario. Deviations from those "key judgments" constitute key risks to the macro forecast and the policy interest rate path implicit in it. According to their importance, some of these risks are illustrated in scenarios presented to the Board along with the main messages about their consequences on the main macro variables (inflation, output and interest rates). During the forecast round, both the staff and Board members may suggest alternative scenarios.

Recent examples of these scenarios include the effects of anticipated, large increases of the minimum wage, loss of credibility of the inflation target, unexpected firming of US monetary policy and tighter external financial conditions resulting from increased risk aversion or fiscal deterioration. Scenarios related to shocks to exogenous variables are based on explicit assumptions about their nature and persistence, and are constructed using the core macro models (eg minimum wage,

Box 1

Monetary policy analysis during the Covid-19 episode

The Covid-19 crisis epitomises the challenges posed by an episode of "Knightian" uncertainty that requires an emergency shift in the process of monetary policy analysis and decision-making. There was no previous experience with or knowledge of a similar shock. There was no external benchmark or event that could shed light on an adequate response.

The shock was believed to have both supply and demand elements of unknown magnitude and persistence. Transmission mechanisms did not work as in normal times. In particular, the strict lockdowns and an unpredictable outlook implied a muted response of consumption and investment to monetary stimuli (Osorio (2025), Falconio and Schumacher (2025)). A financial, internal and external element of the shock became crucial, as the real effects of the pandemic coupled with heightened risk aversion compromised the functioning of the FX and public debt markets, endangered credit supply and threatened financial stability with a run on open-ended money market funds. Thus, a myriad of possible macro-financial outcomes emerged, the probabilities of which were very hard to assess and which required a comprehensive policy response involving several central bank tools (Cardozo et al (2023)). These factors and the simultaneous public policy responses in other fronts (sanitary, fiscal, financial) made it hard, if not impossible, to ascertain a "central scenario", let alone a probability distribution of exogenous and endogenous variables.

Because of the elevated uncertainty and the array of shocks hitting various markets, interest policy rate decision Board meetings were scheduled every month in 2020 (up from only eight a year in normal times). Staff produced and published relatively broad "forecast" ranges for the main variables, without probabilities associated to them. From the policy point of view, efforts concentrated on stabilising financial and credit markets, while the policy rate was reduced gradually. This feature of the policy response was shared by some central banks in Latin America (eg Brazil and Mexico) but differed from the reaction of other central banks in the region (eg Chile and Peru). In the case of Colombia, transmission through traditional demand and credit channels was deemed weak, while the impact of an aggressive interest rate reduction on volatile capital flows, risk premium and the exchange rate was considered risky (Cardozo et al (2023, pp 646–50)).

The gradualism of the interest rate reduction during the pandemic is an interesting issue from the point of view of optimal or robust policy responses. A robust control approach would minimise the maximum loss across a range of possible policy alternatives, even without any knowledge of the probability distribution of different scenarios. This framework seems appropriate when the cost of the worst outcomes from the policies considered is steep (Barlevy (2009, p 44)), as in the Covid-19 crisis. The sharp depreciation of the Colombian peso (COP), the run on open-ended money market funds and the uncertainty about the future effects of the pandemic entailed acute risks to capital flows and financial stability, especially if monetary policy was relaxed too fast. At the same time, a perceived muted response of aggregate demand to monetary policy easing reinforced the arguments for a gradual adjustment of the interest rate.

The gradualist approach taken by the Central Bank of Colombia can also be understood from the classical perspective of optimal monetary policy under uncertainty (Brainard (1967)), although with an interesting twist. As noted, the transmission of monetary policy to aggregate demand was muted by the features of the pandemic. Thus, there was some certainty about a diminished coefficient of the interest rate in an "IS" equation. Ceteris paribus, this would prompt a *more aggressive* policy response to a shock that reduced both activity and inflation (the "demand" component of the Covid-19 shock).

However, at the same time, the financial component of the shock markedly raised the uncertainty about the effect of interest rate shifts on the exchange rate and, thereby, on inflation. Following Brainard´s principle, this would favour a more gradual adjustment of the interest rate. Hence, there were two opposing forces regarding the optimal strength of the policy reaction to the shock. In particular, the gradualist approach could be optimal for a sufficiently large increase in the central bank's uncertainty about the response of the exchange rate to the interest rate. Notice that this argument follows from the narrow focus on inflation, without any consideration of financial stability. These ideas are illustrated in the Appendix through a simple model within Brainard´s framework.

external interest rates and risk premium shocks). Scenarios of policy credibility losses are built using satellite models in which the core specification and some parameters are adjusted to represent the risk.

Besides risk scenarios, four times a year the staff compute "predictive densities" for the main exogenous and endogenous variables of the forecast (Del Negro and Schorfheide (2013), Méndez-Vizcaíno et al (2021)). These are distributions based on the estimated probability densities of shocks in the general equilibrium models used to produce the forecast. The probability densities of these shocks are in turn informed by forecast errors, but their variance or asymmetry can be adjusted according to the staff´s assessment of the risks going forward. Draws from the shock distributions are then included in the general equilibrium models to compute equilibrium paths for the endogenous variables over the forecast horizon. Thus, complete distributions (predictive densities) for these variables are derived from multiple shock draws. Importantly, these distributions account only for the risks represented by the shocks considered. In particular, they do not include uncertainty about the parameters of the models or other sources of risk.

The predictive densities are a key tool to quantify uncertainty and estimate a balance of risks of monetary policy. They are presented to the Board with a discussion of their shifts and the policy trade-offs implied. For example, if supply or currency depreciation risks are prominent at some point in time, the predictive density of inflation will exhibit an upward bias and the probability of values of inflation close to target will be lower than usual, at least in part of the forecast horizon. Consequently, the predictive density of the policy interest rate will be skewed to the upside, while the GDP distribution will show a downward bias.

When providing the policy recommendation to the Board, the staff explicitly consider the initial state of the economy (inflation above/below target, excess demand or capacity, the current stance of policy), the central forecast and a balance of its risks (from predictive densities or risk scenarios). Suppose, for example, that inflation is above – but converging to – target and the policy rate is above neutral. If risks are tilted towards higher inflation over the forecast horizon, staff could recommend a more gradual relaxation of policy than the central scenario would imply.

5. The influence of uncertainty on monetary policy decision-making

The Board of Directors is a plural body with differences among its members on the assessment of macro shocks, transmission mechanisms and risks to the forecast. Hence, it is difficult to think about a "policy reaction function" as a systematic response of the Board to a macro configuration. However, the evaluation of the balance of risks (based on the discussion of the staff´s) is a salient feature of the policymaking process and a key determinant of the policy decision.

More specifically, in the hiking phase of the policy interest rate cycle, the sheer size of the coinciding inflationary shocks and solid aggregate demand in 2022 required a strong policy response from the central bank. Moreover, other factors

related to uncertainty, such as the risk of de-anchoring inflation expectations, reinforced the case for large increases in the interest rate. Ex post, a weaker demand channel resulting from increased uncertainty of economic policy (Osorio (2025)) provides additional support for this course of action.

By contrast, the speed of interest rate cuts has been comparatively low, in view of the still sizeable deviation of inflation from target and the persistence of supply shocks (eg domestic fuel price increases of 45% in 2023). Furthermore, prudent policy responses resulted from an outlook with upside inflation risks or with risks of higher risk premia (with implications for the exchange rate or the neutral interest rate), stemming from a deterioration of public finances or greater international risk aversion. Likewise, the possibility of increased inflation inertia due to long deviations of inflation from target induced gradualism in policy rate cuts.

From the perspective of transmission mechanisms, the latter could be understood as increased "backward-looking" parameters in the Phillips curves that raise the "intrinsic" persistence of inflation. Interestingly, not only the size of but also the uncertainty around these coefficients is relevant as a rationale of a prudent approach to interest rate cuts. From a robust control perspective, a central bank facing greater uncertainty on past inflation coefficients in the Phillips curve would choose to assume large values for them, since they yield the greatest losses that policy should minimise (Barlevy (2009, pp 48–49)).

In the context of the sequence of large inflationary shocks which have occurred since 2021 and the ensuing postponement of the convergence to target, the Board has avoided specific forward guidance. Interest rates have been high and far from any effective lower bound, reducing the need for forward guidance to bolster policy effectiveness. Moreover, the burden of explaining repeated shifts in the expected policy rate path could be sizeable in junctures characterised by the close occurrence of several disturbances. For the same reason, it has been difficult to make statements on future conditional paths of the interest rate. The usual conditioning factors are endogenous variables (eg observed or expected inflation) that may respond differently to the myriads of shocks that may hit the economy. At a very basic level, one can hardly communicate what one cannot predict with some "reasonable" degree of certainty.

Consistent with its inflation targeting strategy, the Board prefers to be as predictable as possible in order to guide expectations along the policy objectives and enhance policy effectiveness. However, the very uncertainty of the environment in which monetary policy has been made in the past five years severely limits the policymaker´s ability to be predictable. It has not been a matter of "seeing through" a small number of conventional supply shocks, but of dealing with several overlapping, large shocks of varied nature, magnitude and persistence.

6. The communication of uncertainty

The communication of uncertainty has been a serious challenge for the central bank in the past five years because market analysts and the general public tend to focus on the "modal" or central scenario. Hence, a conscious effort has been made at the press conference after Board meetings and, especially, in the publication and

presentation of the MPR, to emphasise the degree of general uncertainty of the forecast, its variation and its main sources.

The predictive densities for all variables except the interest rate are published in the MPR and a section on the risks to the forecast is included in this document. It discusses qualitatively the main risks and their effects on the outlook and policy. Quantitative risk scenarios have not been published so far to avoid confusion and long, complex descriptions of the magnitude and persistence of the shocks considered. In the presentation of the MPR, a list of the main risks to the forecast is included, along with their implications for inflation, economic activity and the interest rate. Box 2 shows an example of this list (translated into English). Risks are classified according to their effect on inflation, interest rates and growth, and their balance is consistent with the shapes of the predictive densities of those variables.

As mentioned in the previous section, because of the highly uncertain environment, no specific forward guidance is provided and the data dependence of future policy decisions is emphasised in public statements. Nevertheless, the Board and the staff have communicated in broad terms that, given the large distance of inflation from target, the policy stance will remain contractionary for a long period.

As indicated above, the sequence of shocks of the past four years has produced long departures of inflation from target and has complicated policy decisions and communication. The usual practice of assuming no large new shocks in the forecast has led to an underestimation of the convergence time to target, as such shocks have indeed appeared. In this context, uncertainty regarding future shocks and the future effects of current and past ones poses a challenge to the communication of a credible path of disinflation towards the target. A wide range for the inflation forecast path, reflecting high uncertainty, may undermine the signal of commitment to reaching the target within the policy horizon (typically two years).

Box 2

Forecast risks: The risk balance results in an **upward bias** on inflation and interest rates, and a **downward bias** on growth.

Risks:

- **+ Inflation/interest rates, – growth:**
  - Future real minimum wage increases above inflation + changes in productivity
  - Deterioration in external financial conditions or sovereign risk perception leading to exchange rate pressures or increases in the neutral real interest rate
    - Prospects of deteriorating public finances
    - Uncertainty about external financial conditions (eg Federal Reserve interest rates)
  - Larger adjustments in regulated prices (eg natural gas)
  - Greater inertia and de-anchoring of expectations due to persistent deviations of inflation from the 3% target
- **? Inflation/interest rates, – growth**
  - Impact of US tariff policies
- **– Inflation/interest rates, – growth**
  - Reductions in public spending required to avoid sharp increases in debt
- **+ Inflation/interest rates, + growth**
  - Greater persistence of already observed private domestic demand dynamics and stronger fiscal stimulus

7. Conclusion

The marked increase in uncertainty has been a salient feature of the macroeconomic environment in the past five years. It has come with a slew of inflationary shocks that have posed the most serious challenge to the Central Bank of Colombia in its 26-year inflation targeting regime. Heightened uncertainty has affected the operation of monetary policy on many fronts. The succession of shocks has delayed the convergence of inflation to target, complicated the communication of a convergence horizon and compromised the credibility of the target. Greater external and internal risks have strengthened a forceful cycle of policy rate hikes and induced a cautious phase of interest rate cuts in the midst of large and persistent deviations of inflation from target. Some transmission mechanisms may have been affected by greater uncertainty on economic policy (the demand channel) and the long deviations from the inflation target (inflation inertia). Monetary authorities have avoided forward guidance in a highly uncertain environment and have reiterated the data dependence of future policy decisions.

Uncertainty has been incorporated into monetary policy analysis through risk scenarios and predictive densities of the main endogenous macro variables. The latter have reflected uncertainty in a way that preserves the general equilibrium consistency of the outcomes of different arrays of exogenous shocks. They are useful to assess the probability of specific intervals for inflation, growth and interest rates in the future, and, thereby, to quantify a balance of risks. Communication of uncertainty is carried out with the predictive densities and with a description of the main risks to the macroeconomic forecast and their balance.

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Appendix: a simple model of optimal interest rate policy during the pandemic

Consider a simple short-term macroeconomic model characterised by an IS curve, an open economy Phillips curve, and a negative relationship between the exchange rate (domestic currency units for one foreign currency unit) and the domestic interest rate, inspired by the framework posited by Barlevy (2009) and Brainard (1967):

$y = x - k\,r$ (IS)
$\pi = \pi^T + a\,y + b\,q$ (Phillips curve)
$q = z - (c + \varepsilon)\,r$ (Exchange rate)

where y, r and q are measures of the output, interest rate and exchange rate gaps, respectively. The Phillips curve assumes perfect credibility of an inflation target, π^T, so that inflation expectations coincide with the target. Inflation deviations from target are due to output or exchange rate gaps. In turn, these gaps may emerge because of shocks x and z to aggregate demand and the exchange rate, respectively.

Monetary policy influences inflation through the demand channel (parameter k) and the exchange rate channel. The latter is subject to uncertainty, as reflected by a random component, ε, in the coefficient linking the interest rate to the exchange rate. ε has mean zero and variance σ^2. This is the only source of uncertainty in the economy and its probability distribution is known by the central bank.

According to the equations above, equilibrium inflation is:

$$\pi = \pi^T + a\,x + b\,z - (a\,k + b\,(c + \varepsilon))\,r$$

The central bank chooses the interest rate, r, to minimise the expected square deviations of inflation from target:

$$\underset{r}{Min}\ E[\,(\pi - \pi^T)^2\,] \quad \Rightarrow \quad \underset{r}{Min}\ E[\,(a\,x + b\,z - (a\,k + b\,(c + \varepsilon))\,r)^2]$$

The solution to this problem yields the optimal monetary policy response to the shocks:

$$r = (a\,x + b\,z)\,[\,(a\,k + b\,c) / (b^2\,\sigma^2 + (a\,k + b\,c)^2)\,]$$

Thus, the optimal interest rate response to the composite shock term, $(a\,x + b\,z)$, is given by:

$$h \equiv dr/d((a\,x + b\,z) = (a\,k + b\,c) / (b^2\,\sigma^2 + (a\,k + b\,c)^2) \qquad (1)$$

As noted in the text, the restrictions imposed by the lockdowns and the uncertainty surrounding the effects and duration of the pandemic reduced the transmission of interest rate shifts to aggregate demand (lower k). As a result, the policy response to a disinflationary shock would have to be stronger:

$$\partial h/\partial k = a\,(b^2\,\sigma^2 - (a\,k + b\,c)^2) / (b^2\,\sigma^2 + (a\,k + b\,c)^2)^2$$

It follows that $\partial h/\partial k < 0$ if $\sigma^2 < c^2 + [((ak)^2 + 2\,a\,k\,b\,c\,)/b^2]$. Notice that if $\sigma^2 = 0$, then $\partial h/\partial k < 0$. In other words, in the absence of uncertainty, the policy response to a shock to inflation becomes more aggressive as the reaction of aggregate demand to the interest rate falls. When uncertainty is present, this result will hold as long as the variance of the random component of the effect of the interest rate on inflation

is small with respect to the magnitude of the deterministic component.[3] Intuitively, with a weaker demand channel, the central bank will optimally become more responsive to inflation shocks, unless uncertainty about other transmission mechanisms is too high; in that case, a stronger policy response will raise the variance of inflation around the target and the central bank will opt for a more gradualist approach.

As stated in Box 1, the reduction of the response of aggregate demand to the interest rate during the pandemic came hand in hand with greater uncertainty about the effect of interest rate movements on the exchange rate in the midst of heightened risk aversion, financial market disruption, collapsing terms of trade and volatile capital flows. In the model, this would appear as a higher value of σ^2 . A simple inspection of equation (1) reveals that $\partial h/\partial\sigma^2 < 0$.

Therefore, two opposite forces were affecting the intensity of the policy response to the Covid-19 shock. On the one hand, a weaker impact of the interest rate on aggregate demand required a greater movement of the interest rate. On the other, higher uncertainty about the effect of the interest rate on the exchange rate and inflation called for a more muted response. The final result depends on the perceived strength of these forces. For a sufficiently large increase in the uncertainty on the exchange rate reaction, the gradualist approach would prevail:

$\partial h/\partial k < 0$, $\partial h/\partial\sigma^2 < 0$, $\Delta k < 0$ and $\Delta\sigma^2 >> 0 \quad \Rightarrow \quad \Delta h = \partial h/\partial k\, \Delta k + \partial h/\partial\sigma^2\, \Delta\sigma^2 < 0$

[3] For example, $\sigma^2 < c^2$ is a sufficient condition for this to be true. That is, if the standard deviation of the response of the exchange rate to the interest rate is lower than the mean value of this coefficient, then the result will hold.

Communicating and managing uncertainty: the case of Costa Rica

Central Bank of Costa Rica (BCCR)

1. Introduction

Costa Rica is a small and open economy, both commercially and financially integrated into global markets. This openness makes it particularly sensitive to external shocks, such as fluctuations in commodity prices, shifts in global demand and changes in international financial conditions.

The central bank's primary mandate, as established by law, is to maintain low and stable inflation, consistent with long-term price stability. To fulfil this objective, the Central Bank of Costa Rica (BCCR) has operated under a flexible inflation targeting regime since 2018, aiming for a medium-term inflation rate of 3%, with a tolerance band of ±1 percentage point (pp).

To manage inflationary pressures stemming from excess aggregate demand, the BCCR employs a forward-looking approach. Its main policy instrument is the Monetary Policy Rate (MPR), which is adjusted based on the projected path of inflation and its macroeconomic drivers.

The MPR signals the monetary policy stance and is designed to influence inflation expectations and aggregate demand. As a short-term interest rate, it anchors the cost of overnight liquidity in the domestic market and helps guide other interest rates along the yield curve.

Periods of heightened uncertainty – such as the Covid-19 pandemic, the Russia-Ukraine war and global supply chain disruptions – have tested the resilience of Costa Rica's monetary policy framework. These shocks have influenced the dynamics of inflation, delayed its convergence to the target and posed challenges to policy transmission. In response, the BCCR has strengthened its analytical tools, enhanced communication channels and improved institutional transparency, underscoring its commitment to sound and credible policymaking under uncertainty.

This chapter explores two key questions regarding the BCCR's communication strategy in times of elevated uncertainty. First, how does the central bank incorporate uncertainty into its models and analytical tools for monetary policy decisions? Second, how has its communication strategy evolved to address the challenges posed by an increasingly uncertain environment?

The chapter is structured as follows: It first describes the decision-making process at the BCCR and the communication strategy. Section 3 provides a brief overview of inflation dynamics in Costa Rica. Section 4 refers to how the central bank incorporates uncertainty into its economic analysis, while section 5 addresses the communication of monetary policy. Finally, section 6 presents a recap of the main lessons on communication processes.

2. The monetary policy decision-making process

Monetary policy decisions in Costa Rica are made by the Board of Directors of the central bank, which convenes on a preannounced schedule approximately every six weeks. The annual meeting calendar is approved and published each December. Although the dates are fixed, the Board may hold extraordinary sessions and take policy decisions when macroeconomic conditions require timely intervention.

Since December 2023, the BCCR has adopted a two-day meeting format to enhance the depth and rigour of its analysis and decision-making process:

- **Day 1:** The technical staff, led by the Chief Economist, presents a comprehensive assessment of domestic and external conditions, the inflation forecast and its key drivers. The analysis incorporates probabilistic elements and expert judgment, with discussions focusing on both the central scenario and the risks that could cause inflation to deviate from its expected path. This includes a risk balance exercise, potential shocks to inflation and the output gap and, when relevant, alternative scenarios.
- **Day 2:** The Board revisits the key points from the previous day, addresses outstanding questions and evaluates the policy recommendation submitted by the Chief Economist. Following deliberation, each member states their position and rationale before voting on the MPR.

After the Day 2 meeting, once markets have closed, the BCCR holds a press conference led by the President to announce the decision and explain its rationale. A press release is published simultaneously to ensure consistency across communication channels.

This press conference format was introduced in March 2024. Initially held virtually and co-hosted by the President and the Chief Economist, it has been conducted in person and led solely by the President since September 2025.

3. Inflation dynamics in Costa Rica

In 2019, prior to the onset of international shocks, inflation in Costa Rica hovered around 2%. Inflation expectations, particularly those from the survey, remained at 3%, consistent with the target, while the output gap remained negative. In this context, the monetary policy stance was expansionary: the BCCR reduced the MPR by 450 basis points (bp) over 15 months, while the reserve requirements in local currency were reduced by 3 pp.

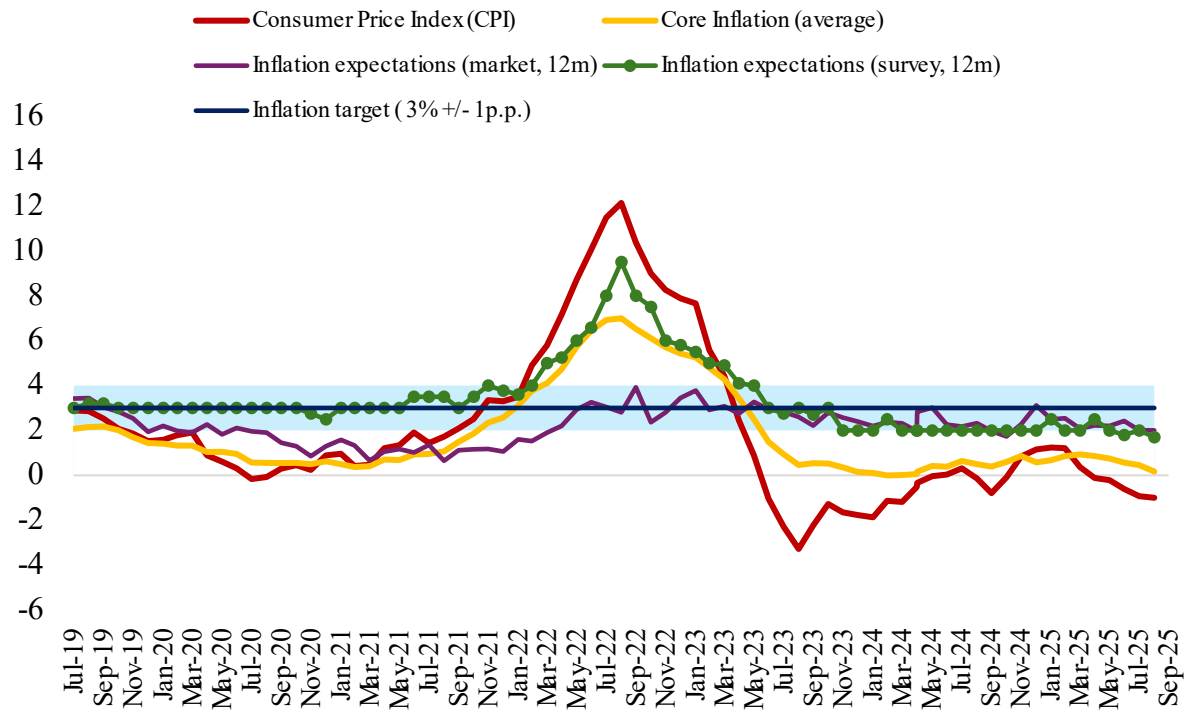
In January 2020, in a context where macroeconomic forecasts were relatively favourable: economic activity was recovering; projected inflation – both headline (measured by the consumer price index) and core – remained within the tolerance range around the target, albeit closer to the lower bound; and public finances were

gradually strengthening,[1] the central bank[2] announced the initiation of an analytical and consultative process to assess the appropriateness and timing of revising its inflation target. However, the outbreak of the Covid-19 pandemic drastically altered these macroeconomic projections, leading to the postponement of the inflation target review.

In September 2020, the BCCR granted a credit facility for financial intermediaries for an amount close to USD 1.4 billion, with a favourable interest rate and terms.[3] Intermediaries, in turn, could channel these resources to the private sector – namely households and businesses affected by the pandemic – under favourable financial conditions.

Costa Rica: CPI inflation, core inflation and expectations

Year-over-year, in percentages — Graph 1



Sources: BCCR; INEC.

In 2022, in response to the international shock to oil and grain prices, local inflationary pressures manifested primarily in fuel and food prices (see Graph 1). Higher prices for raw materials imported by Costa Rica led to an increase in demand

[1] Driven by the implementation of the Public Finance Strengthening Law (9635).

[2] See BCCR (2020).

[3] This measure aimed to alleviate the pandemic's economic effects on consumption, production and employment, thereby helping to minimise the long-term consequences of the crisis on society and the productive sector. Ultimately, it sought to support the survival and medium-term recovery of solvent companies.

for foreign currency, which, along with increased demand from pension fund managers, generated strong pressures on the foreign exchange market.

In response to the acceleration of inflation expectations, and to control second-round effects, the BCCR aggressively increased the policy rate by 825 bp in 11 months and the reserve requirements in local currency by 3 pp.

In September 2022, inflationary pressures began to ease, driven both by the unwinding of international shocks and the timely implementation of contractionary monetary policy by the central bank. At the same time, pressures in the foreign exchange market also moderated.

In March 2023, with both inflation and inflation expectations still exceeding the tolerance range around the target, the central bank initiated a gradual reduction of the MPR and reaffirmed its commitment to making policy adjustments in a prudent, gradual and orderly manner.

A less restrictive monetary policy stance – combined with a slower decline in international commodity prices and rising shipping costs – contributed to a gradual increase in inflation starting in September 2023. Nevertheless, for most of the period since June 2023, inflation has remained negative.

As of late 2025, the central challenge is to restore inflation to positive levels and guide it towards convergence with the established target.

4. Capturing and quantifying uncertainty in economic analysis

Uncertainty is addressed at various stages of the BCCR's analytical process. The cornerstone of its economic forecasting is a semi-structural macroeconomic model developed in house,[4] which provides a coherent medium-term projection of inflation, output, and other key macroeconomic variables.

To better capture the dynamics of inflation projections for the short term (one to three months), the macro model is informed with projections from a set of short-term satellite models. This allows for improved quality of inflation and economic growth projections for the monetary policy horizon.

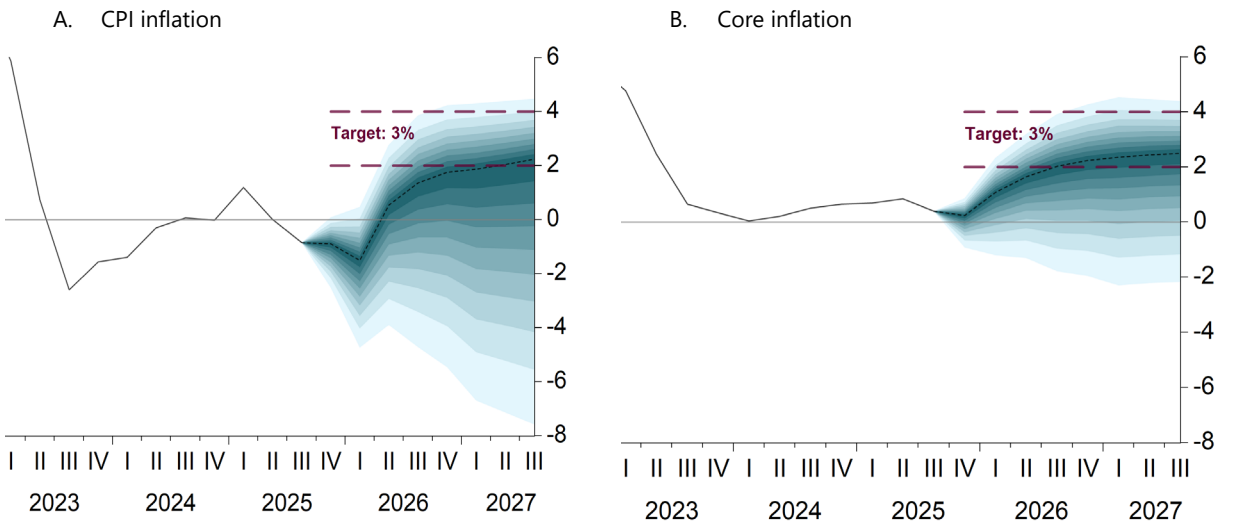
Central forecast paths for headline and core inflation generated by the model are supplemented with probabilistic fan charts and confidence intervals to illustrate the potential range of outcomes. These charts quantify the likelihood of alternative inflation outcomes around the baseline projection (see Graph 2) and illustrate the expected timing of convergence towards the 3% target and its ±1 pp tolerance range.

These fan charts are characterised by asymmetrical confidence bands. Their purpose is to provide the most comprehensive assessment by the central bank of the pressures affecting the forecasted variable, as well as the degree of uncertainty surrounding those pressures (Rodríguez Vargas (2010)).

[4] See Muñoz and Rodríguez (2022).

Costa Rica: general and core inflation forecast[1]

(Quarterly average, in per cent) Graph 2



[1] The graph displays the inflation prediction bands based on CPI and core inflation over the projection horizon. These are conditional forecasts, meaning they incorporate potential monetary policy responses. The darkest band surrounding the central value represents a 10% probability of occurrence. Each successive pair of lighter-shaded bands adds an additional 10%, cumulatively reaching a 90% probability.

Source: BCCR (2025b).

An essential input for the development of the fan chart is the systematic evaluation of the risks associated with the central inflation forecast. This assessment involves quantifying the probability that the actual values of key macroeconomic determinants and exogenous variables will diverge from those assumed in the baseline scenario. Such deviations may materially affect the trajectory of inflation and, consequently, the reliability of the central projection.

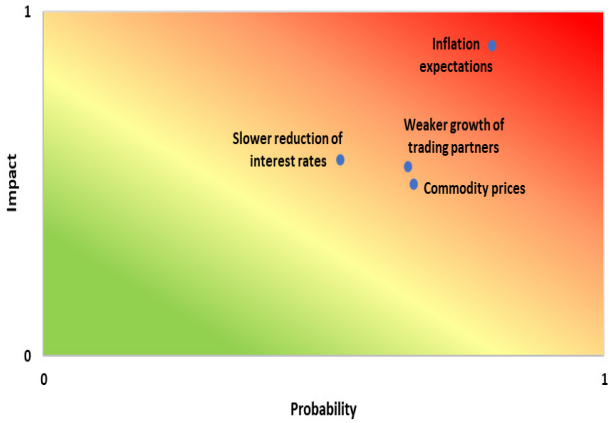
To ensure robustness in this process, the analysis incorporates the informed judgment of the team of economists engaged in the institution's regular macroeconomic forecasting and assessment exercises. Their expertise is critical in identifying potential sources of uncertainty and assigning probabilistic weights to alternative scenarios, thereby enhancing the analytical rigour and credibility of the risk assessment framework.

This balance of risks is subsequently presented and discussed with the Board of Directors during monetary policy meetings (see Graph 3). Where necessary, the assessment is adjusted to reflect the collective position of the Board prior to its inclusion in the Monetary Policy Report, ensuring alignment between staff analysis and institutional decision-making.

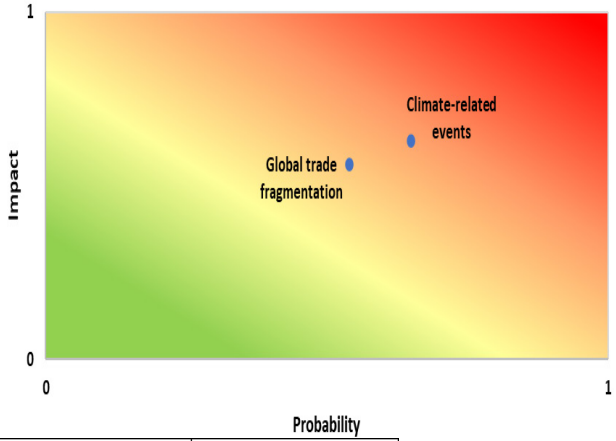
Primary risks to the central scenario

(Quarterly average, in per cent) Graph 3

A. Downside



B. Upside



Score	Impact	Probability
[0.00 - 0.25]	Low	Low
[0.26 - 0.50]	Low to medium	Low to medium
[0.51 - 0.75]	Medium to high	Medium to high
[0.76 - 1.00]	High	High

Source: BCCR (2025b).

To assess the degree of prevailing uncertainty, the BCCR also monitors a range of indicators, including short-term interbank market liquidity, financial market volatility, movements in external commodity prices, exchange rate pressures and forecast errors. During the Covid-19 pandemic and subsequent global disruptions, these indicators played a key role in identifying shifts in the economic environment and informing the risk assessments presented to the Board.

During periods of disruption in key input prices, the BCCR conducts alternative scenario analyses to evaluate the macroeconomic implications of such shocks. These exercises help assess how deviations in commodity prices – such as oil – could affect inflation, output and the external balance relative to the baseline projection.

Although alternative scenarios are not typically published, they have been employed in press conferences to visually illustrate the potential implications for the central inflation forecast should a relevant risk materialise. These scenarios serve as analytical tools to enhance public understanding of the sensitivity of inflation projections to specific shocks.

Graph 4 presents an exercise conducted in June 2025,[5] simulating both a temporary and a permanent upward shock to international oil prices. The graph illustrates the projected impact of each scenario on headline inflation. In this case, the central inflation forecast for the first quarter of 2026 was 1.47%, based on the oil price

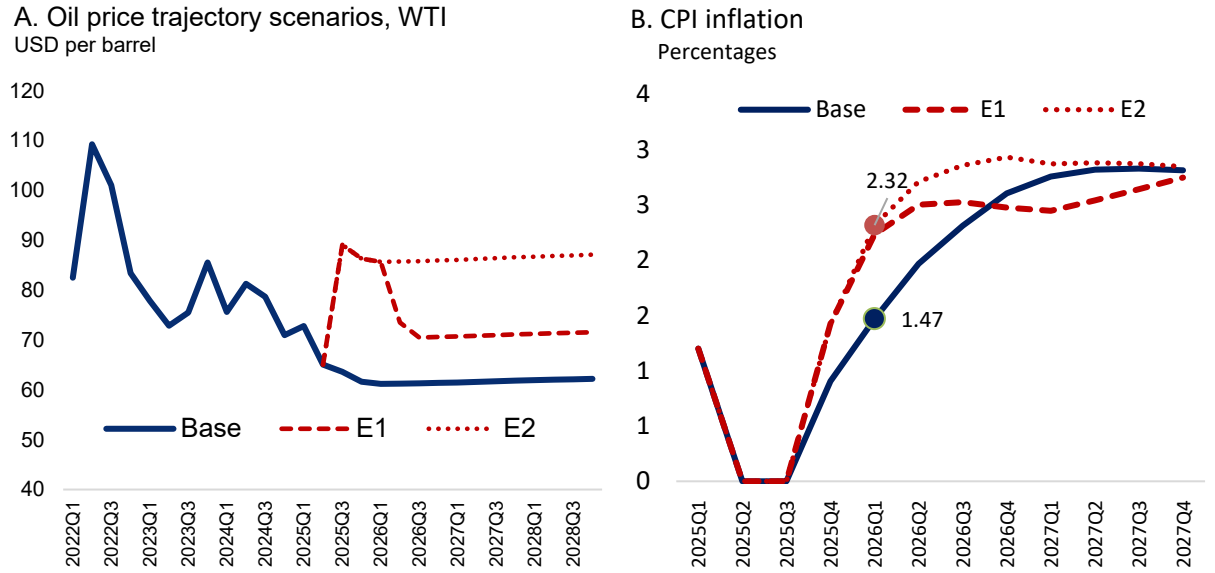
[5] Presented during the press conference held that month.

assumptions embedded in the baseline projection.[6] Both scenarios assume a 37% increase in hydrocarbon prices during the first projected quarter. The dashed lines depict the potential inflation trajectories under each of the simulated shocks.

Scenario analysis, oil price shocks

From June 2025 monetary policy meeting

Graph 4



E1: Transitory shock.
E2: Permanent shock.

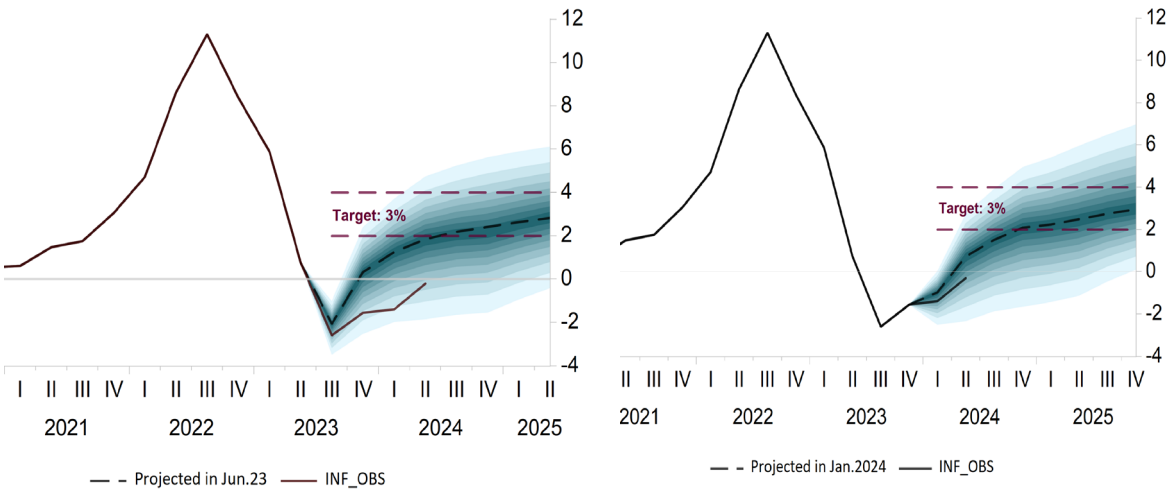
Source: BCCR.

Graph 5 illustrates another example used by the BCCR to communicate uncertainty surrounding its forecasts – particularly when actual outcomes for key variables, such as commodity prices, diverge from the assumptions initially embedded in the projection. In this specific case, both the June 2023 and January 2024 forecasts estimated an inflation path in which inflation would return to positive values more rapidly than it actually did.

[6] The assumed trajectory of international oil prices (futures) is sourced from Bloomberg.

Past inflation forecast and observed inflation

In percentages Graph 5



Source: BCCR press conference, June 2024.

Inflation eventually returned to positive territory in the fourth quarter of 2024 (December) but reverted to negative levels in May 2025.

In addition, the BCCR has progressively expanded its use of high-frequency data, including card transactions, fuel consumption and port activity, to enhance real-time monitoring. While these data sources are valuable for identifying turning points in economic activity, they require careful interpretation due to their volatility and limited historical depth.

By integrating model-based projections, expert judgment and high-frequency indicators, the BCCR ensures that uncertainty is captured both quantitatively and qualitatively, providing the Board with a well-rounded assessment of risks to inflation and growth.

5. Monetary policy communication under uncertainty

The BCCR deliberately avoids making rigid commitments to predetermined policy trajectories. Instead, it articulates its reaction function with transparency, underscoring that future policy decisions will be contingent upon the evolution of incoming data, the projected inflation path and the prevailing balance of risks. This strategy mitigates the risk of fostering unrealistic expectations while reinforcing the institution's credibility.

The *Monetary Policy Report* (*Informe de Política Monetaria*, IPM), published quarterly, is the main vehicle for communicating forward-looking information. It presents baseline forecasts, fan charts, illustrating how inflation and core inflation could evolve under different shocks. During episodes of elevated uncertainty, the IPM

explicitly discusses asymmetric risks, external factors and the expected time frame for inflation convergence to the tolerance range around the target (see Graphs 2 and 3).

In addition to the IPM, key messages are reinforced through press conferences, Board minutes and post-meeting statements. These communication tools aim to maintain consistency across channels while tailoring the level of detail to suit different audiences – from financial market participants to the public.

Communicating uncertainty to the public demands transparency and accessibility. Those are core pillars of the BCCR's communication strategy. Since 2023, it has made significant strides in strengthening institutional communication, including:

- publishing transcriptions of Board discussions, enhancing accountability and fostering public understanding;
- holding regular press conferences immediately following each policy decision, ensuring timely and direct communication;
- enhancing the IPM with fan charts, risk assessments and scenario analyses to better illustrate forecast uncertainty; and
- systematically communicating the balance of risks, both qualitatively and quantitatively, to help audiences interpret the uncertainty surrounding projections.

Communicating uncertainty remains a challenge – particularly with non-technical audiences, who tend to focus on point forecasts rather than probability distributions or risk balances. To address this, the BCCR incorporates visual aids and plain language explanations into its reports, clarifying the implications of uncertainty for inflation and policy. Technical notes are also included in the quarterly IPM to support deeper understanding.

The Bank's recent experience shows that acknowledging uncertainty enhances credibility rather than undermining it. By being transparent about the limits of knowledge and the conditional nature of forecasts, including the transmission mechanism from the policy rate to financial system rates, the BCCR reinforces its institutional commitment to data-driven and adaptive policymaking.

A notable example was the delayed return of inflation to the target range during 2023–25. The Bank clearly communicated that this delay was driven by external shocks – particularly in energy, food and freight costs and exchange rate pass-through – and illustrated this through fan charts and scenario comparisons (see Graph 5). This proactive communication helped anchor expectations and maintain confidence in the policy framework.

As previously noted, in 2020 the BCCR announced the launch of a review process for its inflation target. This initiative was temporarily suspended due to the pronounced volatility affecting both the global and domestic economies. The discussion resumed in 2025,[7] and in preparation for this process, the Bank has actively engaged in public communication through dedicated analytical boxes included in its

[7] The July 2025 IPM stated that "The Central Bank (...) will continue with the detailed evaluation of the components of the current inflation targeting framework, an analysis that is already underway and which may lead to a redefinition of the inflation target or its characteristics".

IPMs. These publications have addressed key topics aimed at enhancing public understanding of inflation dynamics and the explicit inflation targeting framework, with the objective of informing stakeholders about the scope and potential implications of the forthcoming review.[8]

6. Lessons learned and ongoing improvements

The BCCR's recent experience highlights several key lessons for central banks operating in environments of heightened uncertainty:

1. Transparency enhances credibility. Openly addressing risks and uncertainty helps manage expectations and reinforces public trust in monetary policy.
2. Communication is a policy instrument. Clear and effective communication can reduce the need for aggressive policy adjustments by shaping expectations and clarifying the central bank's reaction function.
3. Flexibility is essential. In uncertain contexts, the BCCR prioritises adaptability over precision, adjusting both the tone and content of its communications as conditions evolve.
4. Continuous improvement is vital. The Bank remains committed to enhancing accessibility, developing new analytical and visualisation tools and expanding the use of scenario analysis.
5. Integrate high-frequency data and qualitative insights. Monitoring real-time indicators and media narratives complements traditional macroeconomic analysis and strengthens situational awareness.
6. Forward guidance is context-dependent. While it is effective in anchoring expectations during periods of low uncertainty, its usefulness diminishes in highly uncertain environments – where flexibility becomes more important than precision.

Ultimately, uncertainty is structural rather than transitory. The experience of the BCCR highlights the importance of clear, transparent and adaptive communication for effective monetary policy in a small open economy. By balancing transparency with prudence, maintaining a forward-looking and data-dependent approach with flexibility, and combining analytical rigour with accessibility, the BCCR aims to strengthen policy credibility and foster greater public understanding in an increasingly complex global environment.

[8] As an example, Box 1 of the January 2025 IPM provided a detailed overview of the key elements considered when defining an inflation target.

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Monetary policy decision-making and communication under high uncertainty in Mexico: lessons from two episodes

Banco de México

1. Introduction

In recent years, heightened uncertainty has been one of the most significant challenges for central banks' policymaking. It has encouraged institutions to strengthen their analytical frameworks and to enhance their strategies for communicating with the public. Monetary policy decisions under conditions of high uncertainty require rigorous internal analysis, careful deliberation, broad policy discussions and a collective learning process for well-grounded assessments. Effective communication with the public builds on this foundation but needs to translate the complex analysis into clear messages that convey the institution's understanding.

Uncertainty is, by its very nature, hard to measure, making evidence-based policy analysis more difficult. Researchers have developed insightful methods for measuring uncertainty, such as text-based indices or statistical models that seek to extract information from observable variables. Nevertheless, its true magnitude remains elusive. This constraint on our knowledge makes it all the more important to confront uncertainty openly, recognising its presence in different forms and the limitations it imposes on economic analysis.

To address the challenges posed by uncertainty, a first step is to try to identify its sources. Next, there is the difficulty of attempting to quantify uncertainty, as well as to understand how it may affect the behaviour of economic agents, which ultimately determine macroeconomic outcomes. In relation to the latter point, policymakers face the issue of model limitations given that, in certain situations, existing models may provide a poor guide for the evolution of the economy. Lastly, the possibility of structural change would further imply that models and statistical tools may offer little guidance for what can be expected. These issues are not independent of one another and often reinforce each other.

Effective and robust monetary policy requires analytical frameworks that are adaptable to varying contexts in order to provide well-founded analysis for a host of sources of uncertainty that may be at play at any given moment. It also requires that communication strategies adjust and innovate, if necessary, in order to maintain transparency, enable a clear communication of monetary policy decisions and keep inflation expectations well anchored. To illustrate these challenges from the point of view of the Mexican experience, this article covers two recent episodes of heightened uncertainty: the Covid-19 pandemic and its aftermath and the recent shift in US trade policy.

2. Episode 1: the Covid-19 pandemic and its aftermath (2020–24)

In early 2020, the Covid-19 pandemic caused three large simultaneous shocks that posed an unprecedented test for central banks worldwide. For Mexico, as elsewhere, these shocks not only brought activity to a sudden halt but also created disruptions that shaped the economic recovery and the evolution of inflation in subsequent years. Production restrictions fractured supply chains and generated widespread input shortages, creating a supply shock. Social distancing measures – including mobility restrictions, school and workplace closures, and the suspension of many services – caused a demand shock, with spending collapsing, savings increasing and consumption shifting towards goods that were less affected by the pandemic, and away from services. At the same time, heightened uncertainty and risk aversion triggered a financial shock that led to equity prices falling sharply, emerging market currencies depreciating, term premia rising and sovereign spreads widening.

The global recovery began in the second half of 2020, supported by unprecedented fiscal and monetary support, the lifting of restrictions and the rollout of vaccination campaigns. Expansive fiscal programmes, particularly in advanced economies, sustained incomes and jobs, while accommodative monetary policies and financial market measures preserved confidence. Together with pent-up demand, these actions spurred a rebound in output, though this was uneven across countries. Inflation rose alongside the recovery and by mid-2021 some emerging market central banks, including Banco de México, began tightening policy. In 2022, lingering supply bottlenecks, rising commodity prices and the war in Ukraine drove inflation to multi-decade highs in many jurisdictions, prompting a broad wave of monetary tightening. By 2023–24, global growth had slowed and disinflation was under way.

Mexico's economic trajectory reflected not only these global forces but also distinctive domestic choices. Financial authorities introduced temporary relief measures addressed to debtors, stakeholders and savers. Banco de México adopted a timely and prudent approach. At the onset of the crisis, the central bank launched a comprehensive package of liquidity and market stabilisation measures to restore orderly market functioning. The extraordinary measures ended in the fourth quarter of 2021, as market conditions improved. Regarding monetary policy, the central bank lowered the reference rate from 7% in March 2020 to 4% in February 2021.

As price pressures emerged in 2021, the central bank raised interest rates at every meeting between June and November. Later on, the complexity of the outlook demanded increasingly forceful action. In December 2021, the pace of tightening doubled to 50 basis points per meeting. As inflation continued to rise, the Governing Board took the unprecedented step of raising the policy rate by 75 basis points in June 2022, delivering four consecutive hikes of this magnitude. Smaller increases followed until the end of the hiking cycle in March 2023. In total, the policy rate rose from 4% in mid-2021 to 11.25%, where it remained for a year. During this period, the disinflation process advanced significantly. In March 2024, with the inflation outlook much improved, the Governing Board began to ease monetary conditions. Overall, the policy rate was lowered by 125 basis points during 2024, closing the year at 10%.

Throughout this episode, pervasive uncertainty shaped both the analysis and the decisions of monetary authorities. The unprecedented nature of the shocks

challenged existing models, complicated inflation forecasting and introduced the possibility of large structural changes. Banco de México adapted its responses to the specific challenges at hand. This flexibility was essential to promote stability and confidence during the economic downturn, as well as to keep inflation expectations anchored and preserve credibility when price pressures started to mount.

Quantifying uncertainty and gauging agents' responses proved complex. At first, the magnitude, duration and costs of the pandemic – economic and human – were unknown. Responses by economic agents could not have been fully anticipated at the beginning of the health crisis. For example, while a drop in demand for services by consumers could have been expected, the observed surge in demand for goods came as a surprise. The timing and scale of measures varied widely across countries, shaped by institutional frameworks, cyclical positions and available resources. Whereas in emerging market economies fiscal support was relatively contained, the large fiscal stimulus in advanced economies boosted global demand. For example, Mexican exports and remittances into the economy expanded in 2020–21, outcomes not expected at the onset of the crisis.

During this episode, model and parameter uncertainty was especially acute. The abrupt shift in consumption patterns, the collapse of services activity and widespread supply disruptions raised doubts about whether traditional models of monetary transmission still applied. As in other central banks, policymakers questioned whether interest rate adjustments would influence demand as before, how persistent the shocks to output and consumption might be, and what the implications were for inflation and its expectations. To navigate this environment, Banco de México adopted a data-dependent approach. It also implemented scenario-based analysis to illustrate the potential magnitude and persistence of the economic downturn. These scenarios, published in Banco de México's Quarterly Reports for the first half of 2020, made risks explicit. Once more information about the magnitude of the initial adverse effects became available, the central bank resumed publishing a single central scenario, while continuing to stress the highly complex and uncertain environment. In addition, to cope with various unknowns during this period, the central bank turned to new sources of information in order to track the economy in real time. Alongside traditional statistics, it leveraged new unconventional indicators – Google mobility and social containment indices, contagion and fatality rates, weekly banknote allocations to meet soaring cash demand, and measures of shipping activity – to complement policy analysis and monitor the drivers of production, consumption, savings and prices.

By 2021–22, the main source of uncertainty had shifted from doubts regarding the likely evolution of economic activity to the nature and duration of emerging inflationary pressures. Inflation more than doubled, from 3.5% in January 2021 to 8.7% in August 2022 – the highest rate in two decades. While the upward trend was evident by mid-2021, the timing and magnitude of future price pressures remained unclear.

In this context, the central bank deepened its analytical work to reinforce its communication toolkit. Technical boxes in its Quarterly Reports explained how external shocks were influencing domestic inflation and detailed the evolving contours of its monetary policy strategy. These boxes examined how external shocks fed into domestic inflation – through global food commodity prices, the nature of

price revisions during the pandemic and the asymmetric effects of global shocks on merchandise versus services prices.

Banco de México's policy actions and communication during the pandemic reflected the multifaceted nature of the uncertainty that prevailed during this period. Throughout the episode, the central bank adjusted its communications to better convey its assessment of the economy and its expected path for inflation, and to provide markets with a clearer signal of the central bank's reaction function. All of these changes were made under the recognition that communication with the public is a key instrument in conducting monetary policy and constitutes an effective mechanism for transparency and accountability.

In addition, Banco de México recognised that monetary authorities themselves, through their messages, play a relevant role in expectation formation, particularly in anchoring medium- and long-term inflation expectations. By mid-2021, given the atypical nature of the pandemic shocks, the inflation outlook was changing significantly from one monetary policy meeting to the next. At that time, inflation forecasts were published only four times a year – too infrequently to capture the rapid evolution of price pressures. To address this, the central bank decided to publish forecasts more frequently, providing more timely information on its assessment of inflation dynamics. Accordingly, in August 2021 the Governing Board announced that, from that moment onwards, monetary policy communiqués would include updated projections of headline and core inflation for the next eight quarters. In addition, the communiqués would disclose the vote of each Board member. This timely information gave the public a clearer understanding of the Governing Board's decision-making process and of the central bank's reaction function, thereby helping to mitigate monetary policy uncertainty.

Starting in December 2021, Banco de México began publishing, alongside its annual inflation forecasts, projections for the seasonally adjusted quarterly variations of both headline and core price indices. Unlike annual variations, these measures exclude base effects and therefore provide a clearer picture of the central bank's assessment of the likely persistence of specific price shocks. Distinguishing between temporary and persistent shocks is essential for guiding agents' inflation expectations. This measure was thus intended to address uncertainty about perceived inflation persistence and its effects on the formation of inflation expectations.

From May 2022 onwards, the Governing Board began to include forward guidance on future rate decisions in its policy communiqués. This provided analysts and markets with additional information about Banco de México's assessment of the inflation outlook and, in turn, about its intentions for monetary policy. Importantly, this guidance did not imply a commitment to specific actions. Rather, it served as an indication of the likely path of policy given the information available at the time of each meeting.

Taken together, these measures strengthened Banco de México's transparency and communication policy and supported the effective conduct of monetary policy to contain inflation.

3. Episode 2: shift in US trade policy

The second episode of heightened uncertainty began unfolding even as the effects of the pandemic had not fully faded out. In January 2025, the incoming US administration undertook the America First Trade Policy, which signalled a sharp shift away from its long-standing open trade stance. In February and March 2025, US executive orders announced significant additional tariffs for Mexico, Canada and China, its major trading partners. Tariffs soon became more widespread as a global minimum of 10% was established in April 2025, with several countries facing higher baseline rates. In addition, at the time of writing several sectoral tariff measures involving autos, auto parts, certain metals and their derivatives, lumber and pharmaceuticals have been implemented. The trade relationship between the United States and China has been particularly tense, with several rounds of tit-for-tat tariff and non-tariff measures. Throughout, announced measures were often paused or modified, adding to the overall uncertainty that persisted during this episode.

The shift in US trade policy was particularly concerning for Mexico, given the deep economic integration between the two countries developed over three decades under the North American Free Trade Agreement (NAFTA) and the United States-Mexico-Canada Agreement (USMCA). After negotiated exemptions and pauses to the entry into force of certain announcements, a large number of products exported by Mexico to the United States became subject to an additional tariff of 25% as of March 2025 if not covered by the USMCA, while those that comply with the trade treaty have been exempted from additional tariffs, unless they face their own sectoral tariff measures. While in late October 2025 the final tariff treatment that Mexico will face is still being negotiated, tariffs are expected to be lower than those originally announced in March 2025. Indeed, estimates under current measures imply an average effective tariff rate of 13% under the 2024 structure of Mexican exports to the United States. Nonetheless, in July 2025 the effective tariff rate was 5.5%, partly as a reflection of a significantly increased use of the USMCA by exporters.

The initial tariff announcements, which were heavily directed towards Mexico, suggested that the main risk the country faced was the direct impact of additional trade barriers on its external demand. However, as tariffs were gradually extended to other countries – particularly China – Mexico's relative tariff treatment improved. The main risk shifted from the direct effects that tariffs could have on Mexican exports, to the indirect impact stemming from the effect that the shift in US trade policy could have on its own economy. As tariffs became broad-based, expectations started to shift, considering an economic slowdown in the United States was more likely than before.

In this context, by mid-2025 the Mexican economy performed better than the external environment would have suggested. While investment spending was negatively affected by the overall level of uncertainty, exports kept growing, defying initial expectations. As mentioned, Mexican exporters adjusted towards a greater use of the USMCA. By July 2025 the share of USMCA-compliant exports had risen from under 50% to over 80%. At the same time, some firms front-loaded shipments ahead of tariff deadlines, while others fulfilled contracts despite higher costs, expecting measures to be temporary. Meanwhile, in tandem with a generalised US dollar depreciation, the Mexican peso unexpectedly appreciated. Indeed, despite initial

expectations of a sharp depreciation and episodes of volatility around the dates of tariff announcements, the Mexican peso has tended to appreciate, recording an appreciation of over 10% against the US dollar between January and mid-October 2025.

While the pandemic was dominated by hard-to-quantify shocks that challenged existing models, the US trade policy shift episode has been hard to interpret. Measures have been frequently introduced, revised or withdrawn with little notice. Legal challenges to the administration's tariff authority further increased uncertainty. The result has been an extraordinary rise in measured policy uncertainty, with Economic Policy Uncertainty and Trade Policy Uncertainty reaching record highs in the first half of 2025.[1]

Compared with the pandemic, there was less model uncertainty, as the effects of tariffs on trade and output are relatively well understood in principle. However, parameter uncertainty was acute. The magnitude and the sectoral and regional incidence of the effects depended on factors such as the extent of exchange rate adjustment, the degree of substitution between Mexican goods and other imports in the US market, and the incidence of tariffs across exporters, importers and consumers. General equilibrium quantitative trade models have been central to the analysis. For example, these models made clear that third-country effects play a key role in understanding how the shift in US trade policy affects any given country. In the case of Mexico, the expected impact on prices and output of an increase in US tariffs on imports from Mexico varies depending on whether, for example, China is also tariffed or not, and whether other countries are tariffed at a higher or lower rate than Mexico. However, model predictions are sensitive to assumptions and estimated trade elasticities may vary significantly by product, sector and time horizon. Substitution is limited in the short run, but potentially larger over longer horizons. While these models suggest large negative consequences for Mexico and relatively limited ones for the United States, they do not provide information about the timing of effects. When mechanisms are well known but parameter values are uncertain, sensitivity analysis and observed adaptation can help anchor the assessment.

Uncertainty was also amplified by the difficulty of gauging how firms and households would adapt. A key unknown was the degree to which Mexican exporters would be able to adjust in the short run towards a greater use of the USMCA. For some firms, complying with the treaty may have simply implied bearing an additional administrative burden, while for others it would have also meant adjusting their supply chains. Gaps in our knowledge regarding the firm-level use of the USMCA, as well as about the organisation of their supply chains, made it difficult to benchmark the degree of possible adjustment.[2] These potential micro-level adjustments were hard to anticipate and further complicated the interpretation of aggregate trade data.

[1] See S Baker, N Bloom and S Davis, "Measuring economic policy uncertainty", The Quarterly Journal of Economics, vol 131, no 4, November 2016, pp 1593–636.

[2] Information gathered through Banco de México's firm survey (EMAER – its acronym in Spanish) in April 2025 indicated that nearly 22% of firms that previously did not use the USMCA for their exports to the United States, or that only used it for some exports, had begun or were intending to begin making more use of the treaty. This survey also revealed that there was a group of firms that wanted to make more use of the treaty to export to the United States but did not know how. This suggested

In this setting, Banco de México deemed that the communication strategy for monetary policy decisions would be more effective by taking a cautious stance for its growth and inflation outlook. Given the lack of clarity about US policy goals, advancing conclusions about the likely consequences of announced but not-yet-implemented policy changes could yield undesirable outcomes.

A particular challenge for monetary policy was that US tariffs also posed inflation risks for Mexico on both sides of the balance. On the upside, higher input costs in the United States and the possibility of a peso depreciation threatened to raise domestic inflation. On the downside, a contraction in US and Mexican economic activity could weaken demand and dampen price pressures. In addition, given the observed disinflation and the inflation outlook at the beginning of 2025, the Governing Board judged that a calibration of monetary policy aimed at easing the restrictive stance was consistent with convergence towards the 3% inflation target. As such, during the first half of the year, at consecutive policy meetings from February to June 2025, the policy rate was reduced by four consecutive 50 basis point cuts. After this calibration stage, and having considered the inflationary outlook, the Governing Board deemed it appropriate to continue with the easing cycle and decided on a 25 basis point reduction in each of the August and September meetings, bringing the reference rate to 7.50%. In this context, to guide expectations and clearly communicate its assessment regarding the implications of US tariff announcements, Banco de México emphasised a single baseline forecast, explaining the assumptions underpinning its projections. It also placed greater emphasis on the balance of risks for economic activity.

Beyond the near-term outlook, while the shift in US trade policy poses challenges for the global economy, it also creates opportunities for Mexico under the upcoming 2026 USMCA review. In particular, trade diversion and nearshoring could further strengthen Mexico's export position and deepen its role within North American value chains.

This trade policy episode highlights how external policy developments can influence the outlook for an open economy like Mexico. During the pandemic, the main challenge was assessing the evolution of economic activity in light of the uncertainty regarding the nature of the profound effects caused by the health shock. In contrast, the current episode involves clearer mechanisms, but the parameters determining the magnitude of effects and permanence of policy are unknown. For monetary authorities, this has meant balancing upside and downside inflation risks and adapting communication to explain how the decisions being taken are consistent with the inflation target. The broader lesson is that when uncertainty stems from certain policy measures, central banks must not add to the uncertainty.

that information frictions could play an important role in the micro-level adjustments underlying export activity.

Conclusions

The global economic environment is undergoing profound transformations that have challenged long-held assumptions and added complexity to policy design. While the uncertainty episodes highlighted in this article have been atypically acute, it is clear that uncertainty is not an exception but a constant in monetary policymaking. Uncertainty cannot be eliminated, but central banks can rigorously assess it and communicate its implications with transparency. Indeed, our responses to uncertainty may rest on three pillars: technical rigour, institutional credibility and transparent communication. A robust and adaptive economic analysis, informed by lessons from past episodes, can help guide policy decisions. Recognising the limitations of existing models and prior assumptions is also essential, as central banks must remain vigilant and ready to adjust to a rapidly evolving and often unpredictable economic landscape. To further reduce policy uncertainty, it is important that central banks clearly explain how new information shapes their decisions.

Monetary policy with risk and uncertainty management in Peru[1]

Adrián Armas, Youel Rojas, Rafael Herrada and Nicolas Butrón[2]

"Plans are worthless, but planning is everything."
Dwight Eisenhower

Contents

[1] Prepared for "Monetary policy decision-making and communication under high uncertainties".

[2] Central Reserve Bank of Peru.

1. Introduction

The Central Reserve Bank of Peru (BCRP) has the explicit constitutional mandate to preserve monetary stability. For this purpose, since 2002, the BCRP has followed an inflation targeting regime framework, which includes risk management. The inflation targeting framework establishes a tolerance band for annual inflation of between 1 and 3%, with the interest reference rate to the interbank market as its operative target. Inflation may temporarily deviate from the target range due to supply side shocks or other transitory factors affecting the availability of goods and services. However, the effectiveness of monetary policy is assessed based on its ability to anchor inflation expectations within the target range, and to guide inflation back to the range within a reasonable time horizon following any deviation caused by economic shocks.

The risk management component of the monetary policy includes (i) preserving the pass-through of the policy rate to the structure of interest rates across the financial system and (ii) mitigating the risks associated with partial financial dollarisation (Florián et al (2022)). In an economy with partial financial dollarisation where the central bank is not a lender of last resort in foreign currency, the materialisation of dollarisation-related risks, such as abrupt and significant exchange-rate depreciation, can jeopardise financial stability and erode confidence in monetary policy.

Accordingly, monitoring, containing and preventing these risks is fully consistent with the BCRP's mandate to preserve monetary stability. Thus, the policy rate may be complemented, depending on shocks and financial conditions, by the use of other monetary policy instruments, such as long-run repo operations to ensure the proper functioning of markets, reserve requirements to avoid credit booms and reduce liquidity risk in foreign currency, and interventions in the foreign exchange market to reduce exchange rate volatility and therefore prevent the triggering of a negative balance sheet effect.

By using this approach, the BCRP is committed to anchoring inflation expectations at the centre of the inflation target range, ie 2%, reinforcing its long-term commitment to currency stability.

However, the success of fulfilling this commitment faces the challenge of different sources of uncertainty regarding the current state and future dynamics of inflation drivers. A critical component of the practical design and implementation of monetary policy is risk assessment on the path of future inflation. Monetary policy actions are inherently forward-looking and must be based on a robust evaluation of potential economic scenarios. Given the lags in monetary transmission, future outcomes of current policy decisions are subject to uncertainty and are contingent on the realisation of various factors.

Dwight Eisenhower once said, "Plans are worthless, but planning is everything." This insight applies perfectly to central banking. The BCRP operates in an environment of constant change, where risks to inflation arise from diverse and unpredictable sources.

To navigate this uncertainty, the BCRP adopts a comprehensive risk management framework that relies heavily on scenario analysis. A scenario acts as a contingency plan for a potential risk to inflation. It outlines the transmission mechanisms and

effects of a shock and defines a prepared policy response. In this sense, scenario analysis is similar to stress testing: it identifies vulnerabilities and helps determine how monetary policy should adapt to evolving conditions, such as shifts in the economic forces shaping inflation.

Ultimately, as shocks materialise, many scenarios may never occur or may become irrelevant. Yet the value of scenario analysis lies not in the permanence of the plan but in the discipline of planning. It provides a clear protocol for risk assessment and ensures readiness for larger, unexpected shocks.

To understand this, this paper reviews the forces that shaped inflation behaviour between 2021 and 2023 – a period in which Peru experienced its most pronounced inflationary surge since adopting an inflation targeting regime. Before the pandemic in 2020, inflation was stable and close to the 2% midpoint of the target range, registering 1.9% in 2019. However, a combination of global and domestic shocks subsequently pushed prices well above the 1–3% target band.

In March 2020, the unexpected outbreak of Covid-19 and the associated confinement measures reduced GDP by 30% in the second quarter, exerting downward risks on inflation. To stabilise the economy, policymakers implemented a mix of conventional and unconventional monetary, fiscal and regulatory measures. And as a result, between March and October 2020, inflation averaged 1.75%.

In the post-pandemic period, inflation began to rise rapidly and persistently, driven by global forces that pushed prices upward worldwide. The rapid post-pandemic global recovery created severe supply-demand imbalances, generating bottlenecks and igniting global inflation, which raised import costs. These pressures were further compounded by the Russia-Ukraine war in 2022, which drove up energy and grain prices, amplifying external inflationary forces.

Domestic factors also played a key role in exacerbating and prolonging the inflationary episode. Political uncertainty and capital outflows in 2021 weakened the Peruvian sol and increased imported inflation. In addition, droughts in 2022, the onset of El Niño in 2023, the bird flu outbreak and episodes of social unrest disrupted production and logistics, pushing food prices higher. Finally, synchronous global monetary tightening added financial volatility. As a result, during the period 2021–23, inflation averaged 6.0%. In this context, the BCRP adopted a tight monetary policy stance to influence long-term inflation, by progressively raising the policy rate from 0.25% in July 2021 to 7.75% in January 2023. In April 2024, the inflation rate returned to its target range.

There were five other periods, during this century, in which inflation breached the 1–3% band, yet effective monetary policy actions helped anchor inflation expectations and guide inflation back towards the target. These past experiences also underscore the risk of recurrences when adverse new shocks materialise. However, recurrence is not synonymous with persistence or continuation: the inflation targeting framework – grounded in a credible commitment to price stability, systematic use of the policy rate and transparent communication – is designed to navigate evolving uncertainty, adapt to new disturbances and contain second-round effects, thereby re-anchoring inflation expectations over time.

The BCRP's monetary policy framework has responded effectively and with sufficient flexibility to a dynamic and evolving economic environment. This

framework, which integrates inflation targeting and the management of risks associated with financial dollarisation, has been tested over more than two decades of implementation. During this period, the framework has demonstrated resilience and adaptability in response to a variety of domestic and external shocks, evolving in line with changes in the national and global economic environment.

This adaptability has been made possible through the BCRP's integrated macroeconomic forecasting system, which benefits from the contributions of its technical staff. This institutional arrangement enables the Bank to continuously refine its policy stance, ensuring that monetary policy remains forward-looking, data-driven and responsive to emerging risks and uncertainties.

2. Uncertainty and monetary policy flexibility

Uncertainty is inherently part of monetary policy management, and the BCRP has long operated in a changing environment, responding with a continuous process of adaptation. One of the defining characteristics of the BCRP's approach is its flexibility and capacity to evolve. This has been exemplified in the progressive adaptation of intermediate targets and operational instruments.

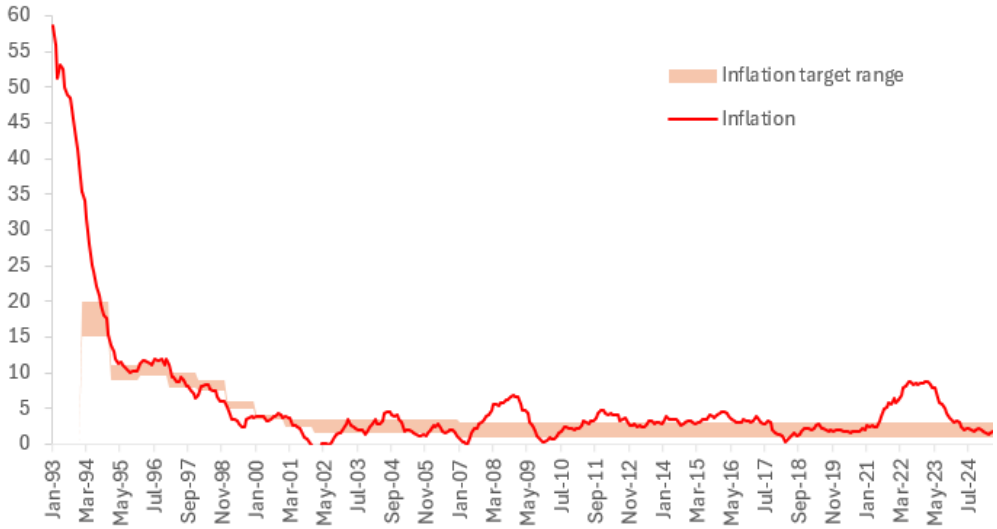
After the hyperinflation of the late 1980s and early 1990s, during the stabilisation programme that followed, the BCRP's disinflation strategy relied on monetary aggregate control. The stabilisation programme and the adoption of the monetary targeting framework unfolded in two key phases. First, in 1990, authorities implemented a critical measure, adopting an administrative floating exchange rate. Second, in 1993, a new constitutional chapter was approved, providing a strong institutional foundation for independent monetary policy by assigning the sole mandate for ensuring monetary stability to the central bank.

During this period, there was considerable uncertainty about the effectiveness of the monetary base targeting framework. The BCRP used estimates of base money demand as its operational target for monetary policy; however, these targets were not disclosed publicly. Aware of the uncertainty surrounding these forecasts in a highly dollarised economy – roughly 80% of deposits and loans were denominated in US dollars – the BCRP retained discretion to revise base money targets and adjust policy instruments as needed (de la Rocha (1998)). This flexible approach allowed Peru to avoid the difficulties faced by other countries that attempted to use base money forecasts as a nominal anchor for inflation expectations (Mishkin and Savastano (2001)).

From 1994 onward, the operational target shifted to the current account balances held by financial institutions at the BCRP, providing a daily measure of system liquidity. Furthermore, the BCRP complemented this approach with elements characteristic of inflation targeting, it began announcing annually declining short-term inflation ranges and enhanced communication about the operational target that would deliver those outcomes. These targets were progressively reduced, from 20% to 15% in 1994 to single-digit levels in subsequent years, reflecting the commitment

to long-term price stability (Graph 1).[3] This arrangement helped to anchor expectations and prepare the ground for a full-fledged inflation targeting regime (Rossini (2001)).

Inflation during the period 1993–2025 Graph 1



Source: BCRP.

In 2002, the BCRP formally adopted an inflation targeting regime, initially setting a 2.5% target with a ±1% tolerance band, evaluated on an annual basis. From 2006 onward, the evaluation became continuous, aiming to always keep 12-month inflation within the target range. In 2007, the target was lowered to 2% with a tolerance range of ±1%. This adjustment sought to strengthen confidence in the domestic currency as a means of payment and store of value, and to reduce vulnerabilities associated with partial financial dollarisation.

At the same time, the BCRP strengthened its forecasting and analytical toolkit to support forward-looking decision-making under uncertainty. With inflation and inflation expectations declining and the projected path of inflation effectively serving as an intermediate guide for policy, the BCRP developed and continuously improved the Quarterly Projection Model (QPM, called Modelo de Proyección Trimestral (MPT) in Spanish) to capture salient features of the Peruvian economy and enhance the quality of inflation projections.

2.1 The risk management approach to facing uncertainty

The Board of the BCRP determines the level of the policy rate on a monthly basis, following a pre-announced schedule that has been in place since 2003. For that purpose, the BCRP uses a monthly integrated macroeconomic forecasting system (see Box 1 and Graph 2). This system draws on the expertise, modelling tools, intuition and judgment as coordinated inputs of all technical departments. To ensure coherence among these inputs, the MPT serves as the central coordinating framework.

[3] See Choy and Quispe (2022) and Armas and Gondo (2022).

Box 1

The forecasting system of the Central Reserve Bank of Peru[4]

To ensure inflation remains within its target range, the Central Reserve Bank of Peru (BCRP) relies on a forward-looking monetary policy framework (Florián et al (2022)). This requires anticipating economic developments and assessing their implications for inflation over a projection horizon of at least two years. As a result, the BCRP has developed a comprehensive forecasting system based on economic models and expert judgment to guide policy decisions.

This forecasting system is a collaborative effort across the institution, especially within the Central Department of Economic Studies. It operates on a continuous basis, with monthly updates feeding into the monetary policy decision-making process. The forecasts also support the Board of Directors, which meets monthly to evaluate economic conditions and determine the appropriate policy stance. Public updates are provided quarterly in the Inflation Report.

The forecasting process involves gathering up-to-date information on domestic economic activity, conducting surveys on expectations (eg inflation, exchange rates and business confidence), and monitoring short-term indicators such as electricity usage and construction materials (see Graph B1). It also includes analysis of global economic trends, commodity prices, international interest rates, and Peru's fiscal outlook and potential output growth.

Since the pandemic period, significant enhancements have been made to improve knowledge of key statistics on the state of the economy, which constitute the initial point forecast. This is particularly true for total GDP and non-primary GDP growth, which are only available with a two-month delay. For that purpose, new statistical models have been implemented to predict the present or *nowcast* these variables. This process includes the incorporation of machine learning models and high-frequency indicators – such as electricity consumption, cement dispatches and import volumes, among others – that provide early signals of economic activity. These approaches combine advanced statistical techniques with daily and monthly data sources to improve the precision of nowcasting estimates, thereby strengthening the forecasting system's responsiveness and accuracy.

Inflation forecasts combine disaggregated price analysis, expert insights and time series models. In parallel, the Bank uses financial programming techniques to generate medium-term projections for key macroeconomic accounts – national output, external balances, fiscal outcomes and monetary aggregates.

All this information is integrated by the Department of Macroeconomic Modelling to produce inflation and output forecasts over a two-year horizon. The core tool is the Quarterly Projection Model, a semi-structural model tailored to the Peruvian economy. It is supported by satellite models such as Dynamic Stochastic General Equilibrium models and others used to estimate unobservable variables like potential output, the natural interest rate and the equilibrium exchange rate.

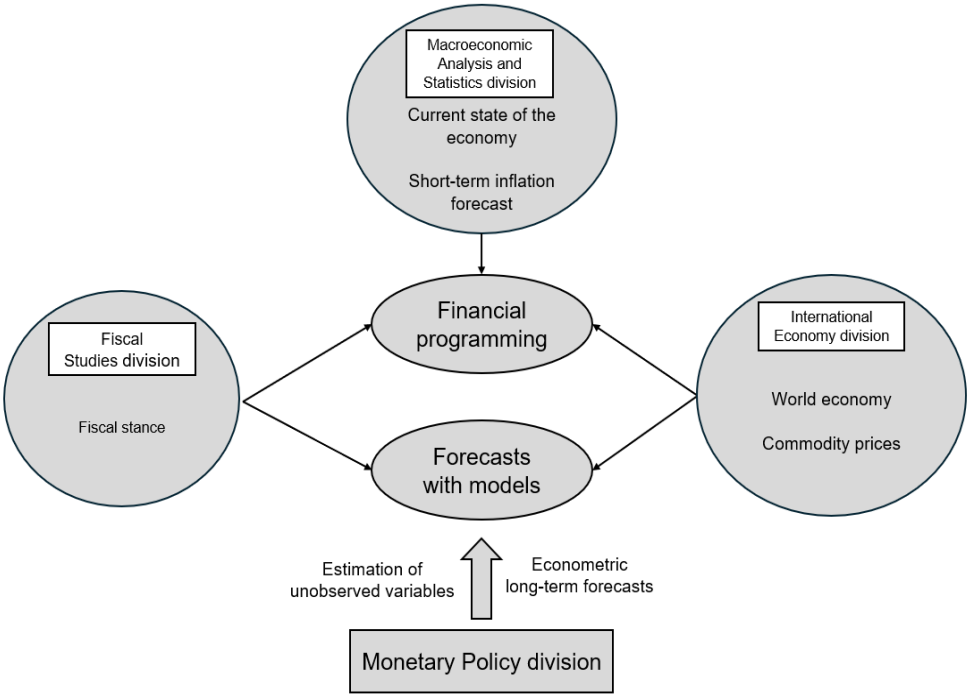
Short-term inflation dynamics are complemented by medium-term forecasts that simulate how different policy paths affect inflation outcomes. These simulations recognise that monetary policy works with lags, typically reaching peak effectiveness within one to two years.

Importantly, the forecasting system combines quantitative model output with expert analysis to improve the quality and credibility of projections. Monthly presentations summarising these projections are delivered to the Board, serving as a key input for monetary policy decisions and as a channel for technical feedback and discussion.

[4] Prepared by Alexander Melendez.

The BCRP forecasting process

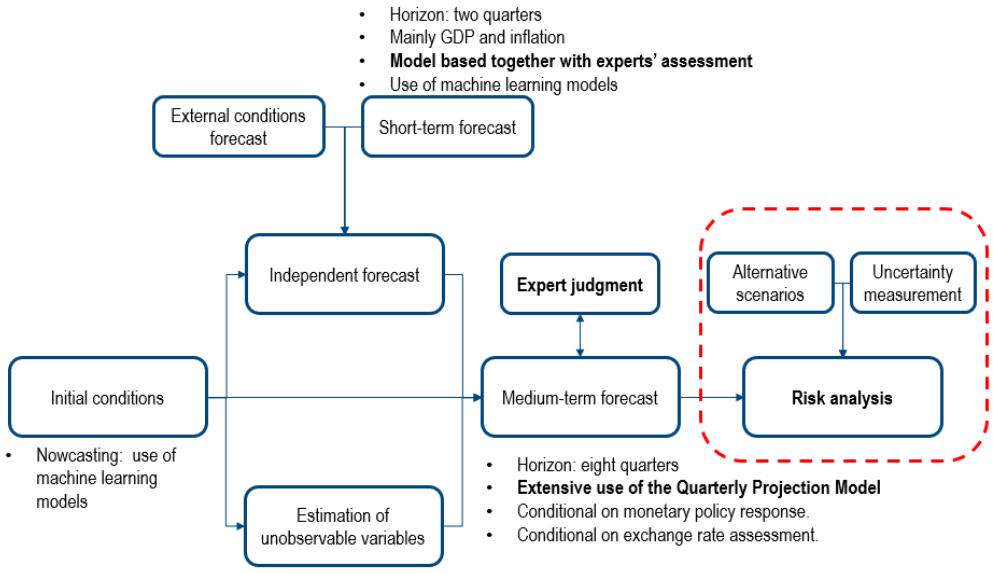
Graph B1



Source: History of the Central Bank and the Monetary Policy of Peru, Volume II.

The monthly BCRP integrated macroeconomic forecasting system

Graph 2



Source: BCRP.

Under the integrated macroeconomic forecasting system, the BCRP's technical staff consolidates all available information on the current state of the economy, along with macroeconomic projections conditional on the monetary policy stance, into a comprehensive presentation delivered to the Board of the BCRP on a monthly basis. This presentation serves as a key input for monetary policy decision-making and provides an important channel of communication between the technical staff and the Bank's Board. It facilitates the exchange of views and enables the Board to provide feedback on recent economic developments, thereby strengthening the analytical foundation of policy decisions.

This monthly presentation features a baseline medium-term forecast along with deviations presented as alternative scenarios. It also incorporates expert judgment on the likelihood of these scenarios. Together, these elements serve as key inputs for risk analysis.

Risk assessment plays a key role in quantifying the uncertainty embedded in the economic forecasting process, particularly regarding the trajectory of key macroeconomic variables. The BCRP forecasts are elaborated on the basis of a risk management approach that focuses on events with a low probability of occurrence, but which may have strong impacts on the economy. This is important because monetary policy decisions are based not only on the central scenario but also on a more comprehensive outlook on the future evolution of the economy. Under this approach, the baseline forecast scenario is the most likely future scenario, which is estimated considering all relevant information gathered at the BCRP.

In the presentation of forecasting to the Board, the technical staff integrates uncertainty explicitly into its macroeconomic analysis through a monthly risk assessment of inflation that combines two stages: (i) a central scenario, which is the most likely forecast for inflation and the economy; and (ii) a balance of risks, that explicitly presents the factors that could make the actual outcome deviate from the central scenario.

In the first stage, the central scenario or baseline projection of inflation and key macroeconomic variables are agreed based on a combination of data-driven forecasts informed by soft information and the judgment of specialists, which deliver the most likely assumptions about the domestic and international environment.

Then, in the second stage, the risks around the baseline are quantified based on risk scenarios, which are separate point forecast scenarios from the baseline. Risks treated as separate scenarios represent potential and important deviations from the baseline forecast due to different assumptions about the domestic and international environment, such as demand shocks, domestic supply shocks or financial shocks. They also represent positive or negative shocks to the main endogenous variables and capture low-probability, high-impact variations from baseline assumptions. Each risk includes both a qualitative description of possible shocks and a quantitative assessment of their probability and impact.

This way of describing risk as scenarios serves well for communication between the technical staff and the board of directors and the public, as they are portrayed as distinct possibilities rather than a continuous distribution. They become intuitive and easy to communicate as they simplify the overall risk spectrum into a few scenarios with clear and distinct narratives for each alternative. Thus, it allows the BCRP to

communicate not only what it expects but also what could go wrong or better than expected and how likely that is.

The overall uncertainty of these risks is communicated using two tools: (i) the balance of risks of inflation, in which each risk is explicitly weighted by the subjective probabilities attributed to their occurrence; and (ii) fan charts, which show predictive distributions around the central forecast, whose variance and skewness are adjusted to communicate the view of the balance of risks.

The balance of risks includes both a qualitative description of possible shocks and a quantitative assessment of their probability and impact. It allows the BCRP to communicate not only what it expects but also what could go wrong or better than expected and how likely that is. This balance of risks is central to the communication strategy. It signals whether the risks are mostly upward (inflation likely to exceed the target), downward (inflation likely to fall below target) or balanced (neutral risks). This assessment helps markets, analysts and the public understand the possible direction of future monetary policy even if the central projection does not change.

Fan charts depict risk as probability bands. They characterise the full spectrum of risk around the central forecast using statistical distributions, which are adjusted judgmentally to reflect skewness (asymmetric risks) and variance (uncertainty magnitude). Although fan charts are more complex to communicate, they are useful to show the full spectrum of uncertainty, and how the uncertainty quantification is predicted to manifest in the forecast horizon (see Box 2).

This process shows that the BCRP forecasts are elaborated on the basis of a risk management approach that focuses on events with a low probability of occurrence, but which may have strong impacts on the economy. Under this approach, the baseline forecast scenario is the most likely future scenario, which is estimated considering all relevant information gathered at the BCRP.

2.2 Constructing risk scenarios

Constructing scenarios is critical for central banks operating in an environment of constant change, where inflation risks arise from diverse sources. Scenarios serve as contingency plans that outline transmission mechanisms and prepared responses to potential shocks. While many scenarios may never materialise, the process of planning strengthens risk assessment and ensures flexibility in monetary policy, enabling central banks to respond coherently and effectively to evolving economic conditions.

In the forecasting process, the central projection represents the most probable path for key macroeconomic variables, particularly inflation. However, to account for uncertainty and potential deviations from this baseline, risk scenarios are constructed. These scenarios incorporate a variety of shocks – often more than one – and are categorised based on their distinctive effects on the economy. Specifically, each scenario is built around specific assumptions that, while unlikely, could have a significant impact on inflation. For example, the following four risk scenarios have typically been categorised and discussed:

Box 2

The BCRP fan chart and balance of risks[5]

Since 2002, the Central Reserve Bank of Peru (BCRP) has used fan charts in conjunction with the balance of risks in its Inflation. Reports to convey uncertainty surrounding its macroeconomic forecasts (BCRP (2008, 2011, 2019) and Winkelried (2012)). These tools are core elements of the monetary policy communication strategy and were adapted from the methodology originally designed by the Bank of England (see Britton et al (1998)).

The fan chart visually represents the range of possible outcomes around a central projection using a probability distribution. The darkest central band marks the mode (the path with the greatest probability density), while lighter surrounding bands indicate progressively lower probabilities for alternative paths. Each fan chart has a forecast range up to 24 months. Each period specifies an asymmetric probability distribution characterised by three parameters: the mode and two standard deviations (σ_1 and σ_2), which capture variability to the left and right of the mode.

The fan chart displays cumulative probability bands – typically 18 bands covering 90% of the probability mass – rendered from darker (central) to lighter (outer) shades (see Graph B2).

To model the distribution of the projected variable we use a split normal distribution with the mode μ at the centre and two standard deviations – one on the left, σ_1, and one on the right, σ_2. Its density is:

$$f(x;\mu,\sigma_1,\sigma_2) = \begin{cases} \sqrt{\frac{2}{\pi}}\left(\frac{1}{\sigma_1+\sigma_2}\right)\exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma_1}\right)^2\right], x \le \mu \\ \sqrt{\frac{2}{\pi}}\left(\frac{1}{\sigma_1+\sigma_2}\right)\exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma_2}\right)^2\right], x > \mu \end{cases}$$

This collapses into a symmetric normal distribution when $\sigma_1=\sigma_2$; in general, the asymmetry arises because $\sigma_1 \neq \sigma_2$, as this signals upward or downward bias.

The mode μ of the fan coincides with the baseline (central), while the mean μ is calculated as the weighted average of alternative scenarios, using the probabilities provided by expert judgment. The asymmetry of the fan thus arises because the "side" with the biggest standard deviation would contain the mean. Then, the two side-specific standard deviations are obtained by the differences between the mean μ and the mode μ (which signals the skewness) and the variance Ω of x:

$$\bar{\mu} - \mu = \sqrt{\frac{2}{\pi}}(\sigma_2 - \sigma_1), \qquad \Omega = \left(1 - \frac{2}{\pi}\right)(\sigma_2 - \sigma_1)^2 + \sigma_1\sigma_2$$

Because a distribution is constructed for each future period, the collection of distributions forms a three-dimensional "mountain range" over time; and when viewed from above, it becomes the two-dimensional fan chart. The volatility of the distribution is increasing over time by a parameter of persistence.

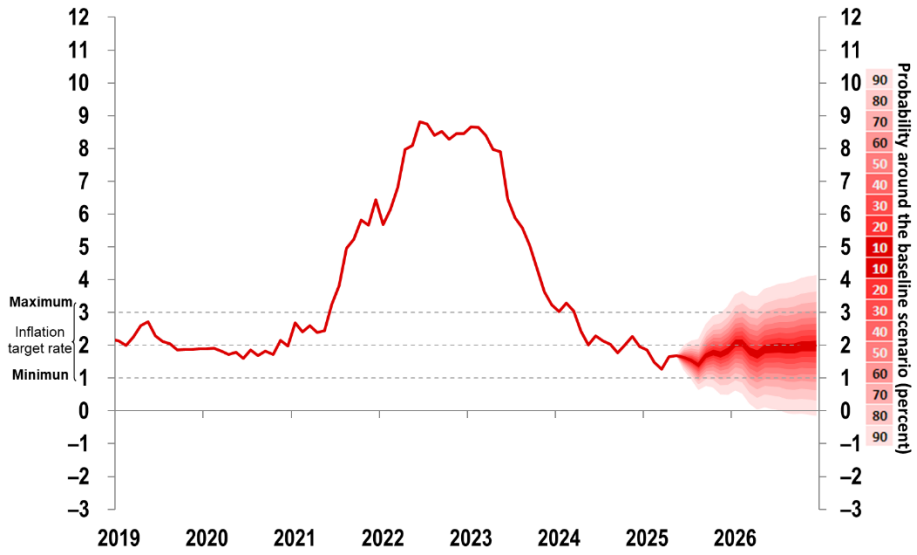
The widening of the fan with the forecast horizon reflects the calibrated persistence of forecast errors and the higher uncertainty embedded at longer horizons.

The shape of the fan chart visually reflects the balance of risks. The balance of risks is a structured assessment of potential events, or "shocks," that could cause inflation to deviate from the central forecast. These risks are categorised (eg internal/external demand, financial and supply side) and weighted based on their perceived probability and potential impact (see Graph B3). The net effect of these weighted risks determines the overall "bias" or "tilt" of the forecast. Therefore, while the width of the fan chart illustrates the overall level of uncertainty (variance), any asymmetry or "tilt" directly reflects the balance of risks. An upward tilt, for instance, indicates that upside risks predominate.

[5] Prepared by Luis Zapata.

BCRP inflation forecast fan chart

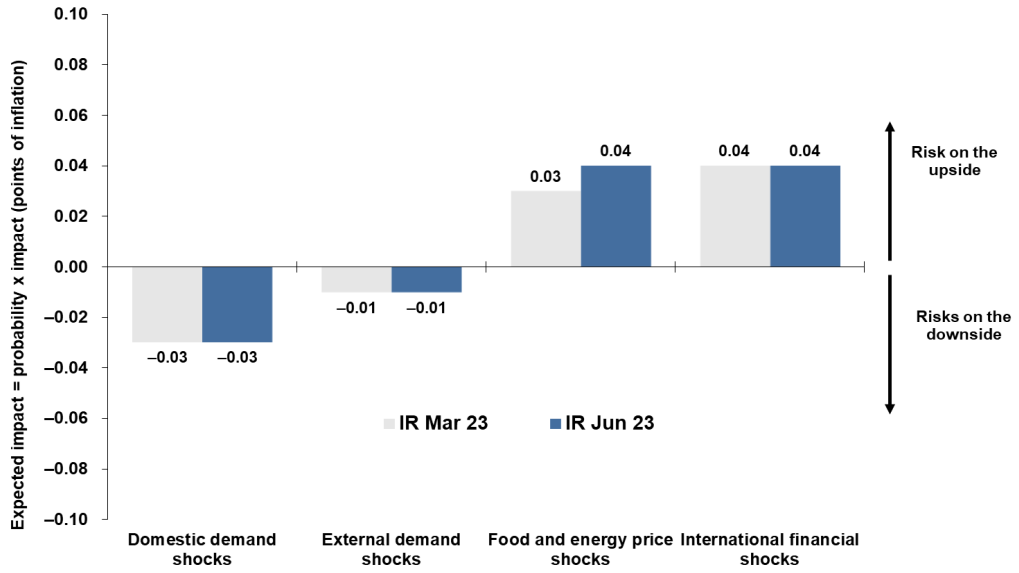
Graph B2



Source: Inflation Report BCRP June 2025

BCRP balance of risks for inflation forecast

Graph B3



Source: Inflation Report BCRP June 2023.

Based on a uniform methodology and consistent presentation projections, via the fan chart and the balance of risks, the BCRP can communicate the range and likelihood of possible outcomes for inflation, and it helps to align market expectations with the central bank's inflation target.

1. **Supply shock scenario**. This scenario considers potential supply side disruptions, both domestic and external, that could affect energy and food prices. Examples include natural disasters, supply chain breakdowns and other unexpected events. The MPT is prepared to capture both the direct impact on inflation and the indirect effects through second-round impacts on other components of inflation.
2. **Financial shock scenario**. This scenario simulates a stressed financial environment, such as exchange rate pressures triggered by a loss of confidence in Peru's economic performance, a rise in country risk or disturbances in external financial markets. These conditions can amplify inflationary pressures through currency depreciation and tighter financial conditions.
3. **External demand shock scenario**. This scenario reflects a global economic slowdown that reduces demand and prices for Peru's export products. Its transmission channel results in a decline in domestic growth prospects and an increase in country risk, which can have deflationary effects.
4. **Domestic demand shock scenario**. This scenario outlines a weakening of domestic growth expectations, often linked to internal instability. The slowdown in economic activity and rising country risk can produce deflationary pressures, depending on the nature and persistence of the shock.

Each scenario can push inflation either upward or downward, depending on the characteristics of the shocks involved. The expected impact on inflation is calculated as the deviation from the central projection, weighted by the probability of each scenario occurring. Aggregating these weighted impacts provides both the Board and the public with an overall sense of the bias these risks introduce into the inflation forecast.

3. Robustness of the framework to different sources of uncertainty

The BCRP's risk assessment framework is designed to remain robust under different sources and types of uncertainty by using a combination of structural macroeconomic models, time series forecasting tools and expert intuition and judgment.

Statistical uncertainty. One common source is statistical uncertainty, which arises because key variables are not directly observed but estimated, often with imperfect models and limited data. To address this, the BCRP combines model estimations with observable indicators and judgment. For example, to estimate unobservable variables – such as the output gap and the natural rate of interest – the common practice is to consider a wide range of methodologies. This diversity reduces the risk of model misspecification and provides a richer basis for discussion about what might be driving changes in these estimates. In addition, the BCRP complements such estimates with signals from macroeconomic, microeconomic, financial and credit market indicators, which are directly observable. This combination of models and indicators, together with expert judgment, helps prevent any single estimate from dominating the analysis. In practice, this approach produces wider predictive intervals, but more realistic outcomes.

Another source of statistical uncertainty is the imperfect knowledge of the initial state of the economy. To address this, significant improvements have been made to enhance the accuracy of key statistics at the starting point of the forecast and in short-term projections. In particular, new statistical models have been implemented to nowcast these variables and to improve short-term forecasting. These models incorporate machine learning techniques combined with high-frequency indicators – such as electricity consumption, cement dispatches, import volumes and financial variables – that provide early signals of economic activity. By integrating advanced statistical methods with daily and monthly data sources, these approaches have improved the precision of nowcasting and short-term forecasts, thereby strengthening the forecasting system's responsiveness and accuracy.

Known unknowns uncertainty. Another category represents identifiable risks whose transmission channels are understood, but whose timing and magnitude remain uncertain. Examples include external demand shocks, commodity price swings, political uncertainty or shifts in global financial conditions. These risks are incorporated through alternative scenarios, each adjusting one or more assumptions – for instance, lowering trading-partner growth to simulate weaker external demand, raising oil prices to model a supply shock or changing the expected path of US interest rates to capture global financial tightening. This is important because monetary policy decisions are based not only on the central scenario, but also on a more comprehensive outlook on the future evolution of the economy under different assumptions, which provides a quantitative measure of each risk's impact. The balance of risks aggregates these scenarios by assigning subjective probabilities and evaluating their weighted effect on the forecast. This assessment is communicated visually by the fan chart bias to reflect asymmetry in risks.

Unknown unknowns uncertainty. Finally, monetary policy also faces an unknown unknowns type of uncertainty, which refers to events that cannot be precisely anticipated or modelled, such as sudden natural disasters, pandemics or global crises. These events can only be described qualitatively but not quantitively in terms of probabilities (Kay and King (2020)).[6] While these cannot be included in formal probability-based scenarios, the BCRP addresses them qualitatively and through preventive macro-financial policies, such as maintaining adequate international reserves and ensuring financial system liquidity, to safeguard the monetary transmission mechanism. In addition, the BCRP sporadically conducts stress tests for very severe implausible scenarios. These scenarios serve as a complement to the probabilistic toolkit, allowing policymakers to explore extreme regimes and nonlinear dynamics beyond typical distributions. One example of this is the so-called Armageddon scenario, although no probability is attached to its occurrence, it informs about possible macro-outcomes and the extent of policy responses after a catastrophic economic event.[7]

[6] Kay and King (2020) define unknown unknowns as states of the world to which we cannot attach probabilities because we cannot conceive of these states. Even if we anticipate them, expressing such events in probabilistic terms is misleading. Instead, we can only frame them through narratives.

[7] This scenario serves as a stress test designed to simulate extreme and catastrophic economic conditions. It is constructed around a coherent narrative that combines multiple severe shocks, each of which has historically represented a maximum observed change in key exogenous variables. For

When dealing with these sources of uncertainty in risk analysis and forecasting, priors are essential for decision-making. They serve as anchors to guide analysis when data are incomplete or risks are hard to quantify. Priors can take two complementary forms: quantitative probabilities and qualitative narratives. A prior as a probability offers a quantified judgment about the likelihood of a risk scenario. This probabilistic prior is useful when facing known unknowns uncertainty as it can provide a numerical starting point for risk modelling and scenario analysis.

However, when uncertainty runs deeper and unknown unknowns emerge, data are scarce and a prior as a narrative becomes essential. The narrative prior is a qualitative story built from historical experience, expert judgment and intuition about how a risk scenario may unfold. The full narrative view may be incomplete and partial, but using narrative priors not only supports model development but also enhances interpretability and fosters discussion around underlying assumptions. For instance, narrative priors proved invaluable during the early stages of implementing the inflation targeting regime during the period 2001–02, when calibrating the forecasting model was necessary due to the monetary policy regime change and the unprecedented low inflation levels not seen for decades.[8]

It is important to note that unknown unknowns uncertainty can eventually evolve into a form of known unknowns uncertainty. Once these unforeseen events occur and new information becomes available, their transmission mechanisms are reassessed to gauge their magnitude and impact. At that point, they transition from being completely unpredictable to partially understood risks.

A clear example is the global Covid-19 pandemic. Before the outbreak in March 2020, historical experience with events such as the 1918 influenza pandemic or Ebola provided some basis to construct a prior to anticipate potential economic effects. Early scenarios considered localised impacts in China and possible spillovers through international trade. However, these assumptions proved inadequate when an unprecedented global pandemic struck, causing severe disruptions worldwide.

Covid-19 triggered a sudden and profound shock to both global and domestic economies. On the demand side, it caused a global contraction, reduced household purchasing power and heightened uncertainty; on the supply side, it disrupted supply chains and required strict social distancing measures that constrained production. These combined effects led to sharp income losses for households and liquidity shortages for firms, limiting their ability to meet financial obligations. In Peru, GDP contracted by 30% in the second quarter of 2020. In this context, credit risk and non-performing loans increased, restricting access to financing and amplifying the disruption of the payments chain. Accordingly, the uncertainty surrounding the pandemic's economic effects and the required policy actions became a source of uncertainty and a central challenge for decision-makers.

instance, the scenario may include an exceptionally intense El Niño event, a sharp increase in risk premiums, a significant currency depreciation, cost-push inflationary pressures and a deep global financial crisis. While each of these shocks is individually extreme, the Armageddon scenario integrates them into a single, compounded narrative. The objective is not to assign a probability to its occurrence, but rather to explore the macroeconomic consequences and assess the resilience of the economic structure and policy framework under the most adverse conditions imaginable.

[8] In 1997, after 27 years, inflation reached a single-digit level of 6.4%, a rate not observed since 1972, when inflation was 4.3%. In 2001 and 2002, inflation fell below 3% (at –0.13% and 1.5%, respectively), levels not seen since 1960, when inflation stood at 2.4%.

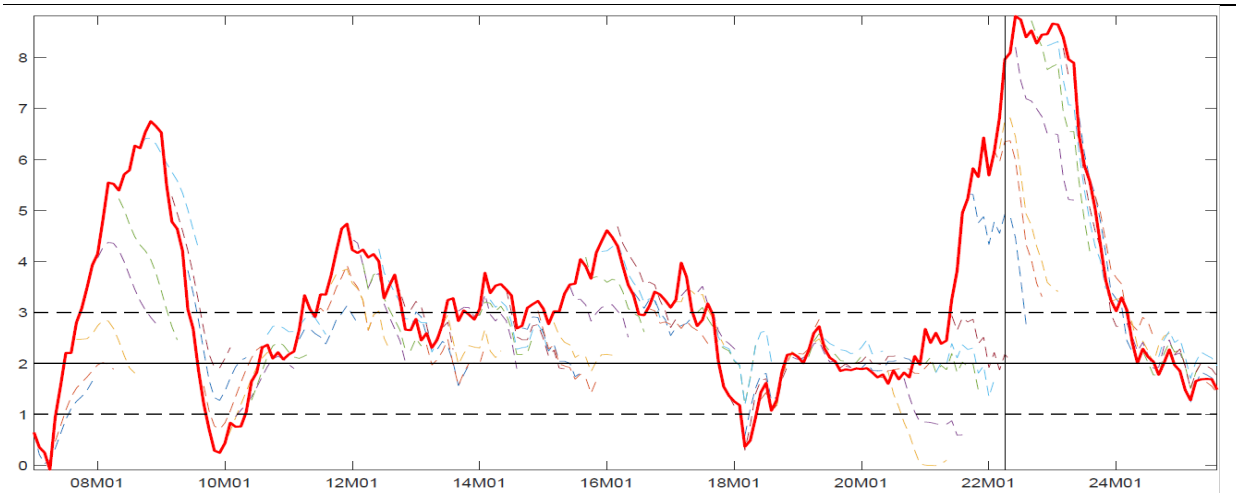
To manage uncertainty surrounding the economic impact of Covid-19, the analytical framework was enhanced by integrating new models and refining existing ones with additional variables and mechanisms. These improvements allowed for the inclusion of epidemiological dynamics, systemic financial risks, abrupt expectation shifts and mobility restrictions.

To address the impact, the BCRP implemented a mix of conventional and unconventional measures aimed at: (i) preventing a credit crunch; and (ii) providing sufficient liquidity to the financial sector to mitigate the impact of external and domestic shocks on financial stability (Montoro et al (2020)).

A key unconventional measure was the launch of the Reactiva-Perú programme. Its design required careful planning to address uncertainty and ensure effective implementation. The process began in mid-March 2020, alongside other actions such as reducing the policy rate to a historic low of 0.25% and lowering reserve requirements. On 26 March 2020, the BCRP Board approved a new liquidity injection instrument: credit repos guaranteed by the national government (see Montoro et.al (2025)). Initially set at PEN 30 billion (4.1% of GDP) and later expanded to PEN 60 billion (8.2% of GDP), Reactiva-Perú provided government-backed credit guarantees to ensure broad coverage. The programme successfully prevented a collapse of the payments chain, reduced defaults and supported economic recovery (Acurio et al (2023); BCRP (2021a,b)).

Other unforeseen shocks are also constantly present in the economy. Even though the forecasting framework is designed to measure various sources of uncertainty, it remains vulnerable to these sudden shocks. Graph 3 illustrates this by comparing the actual inflation outcomes with the baseline forecasts published in each Inflation Report from 2007 to 2025. Significant deviations between forecasts and realisations highlight the materialisation of different sources of uncertainty, often driven by unexpected events that were not anticipated at the time of the initial projection. Box 3 shows how the different tools to measure uncertainty were adapted after the unexpected El Niño shock.

Inflation projections and realised inflation — Graph 3



[1] Note: x-axis is labelled year- first month of year (M01)

Sources: BCRP Inflation reports.

Box 3

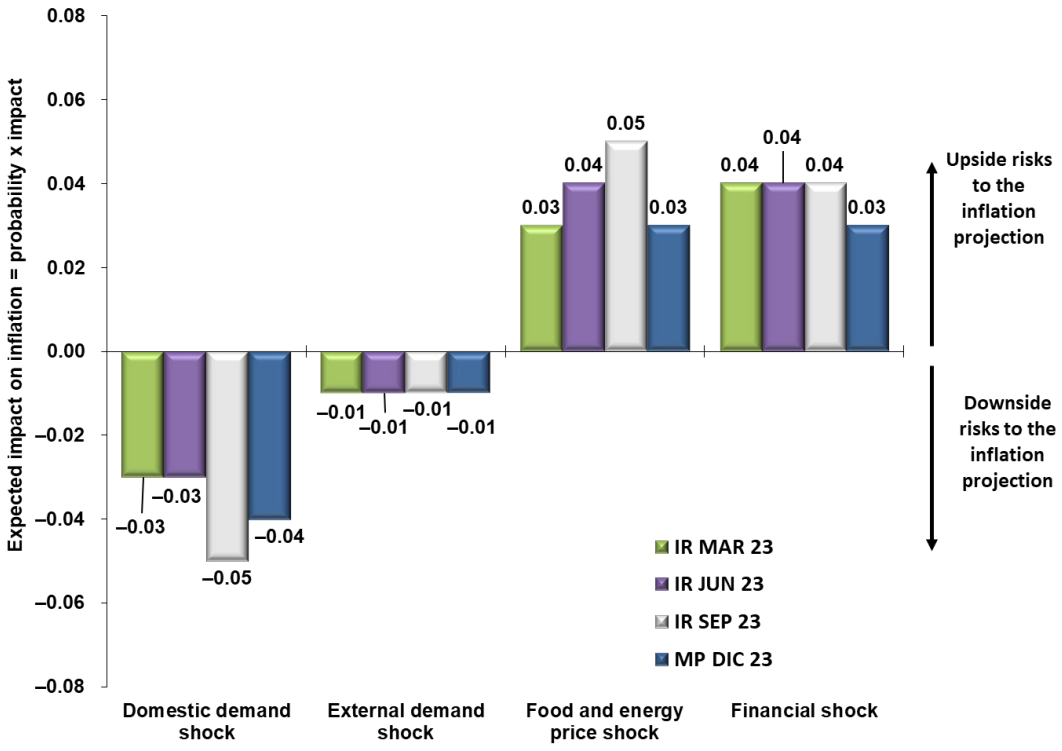
Navigating through uncertainty after large shocks[9]

When a sudden unexpected large shock appears, the forecast and the assessment of risk are revised accordingly as new updates and more information about the event are gathered. This box presents the evolution of the uncertainty communication after the 2023 El Niño surprise realisation.

The 2023 El Niño surprise

The period between March and December 2023 provides an example of this framework in action (see Graph B4). During this period, the Central Reserve Bank of Peru (BCRP) adapted its diagnosis, projections and communication in response to a "surprise" shock: a coastal El Niño phenomenon (El Niño Costero, FEN) whose intensity and economic impact were greater than initially anticipated.

Balance of risks during 2023 — Graph B4



Source: Inflation Report BCRP 2023.

At the beginning of the year, the main concerns shaping the BCRP's forecast were the lingering effects of social conflicts and political instability. While climatic events were mentioned as a potential risk, they were not yet the dominant feature of the analysis.[10]

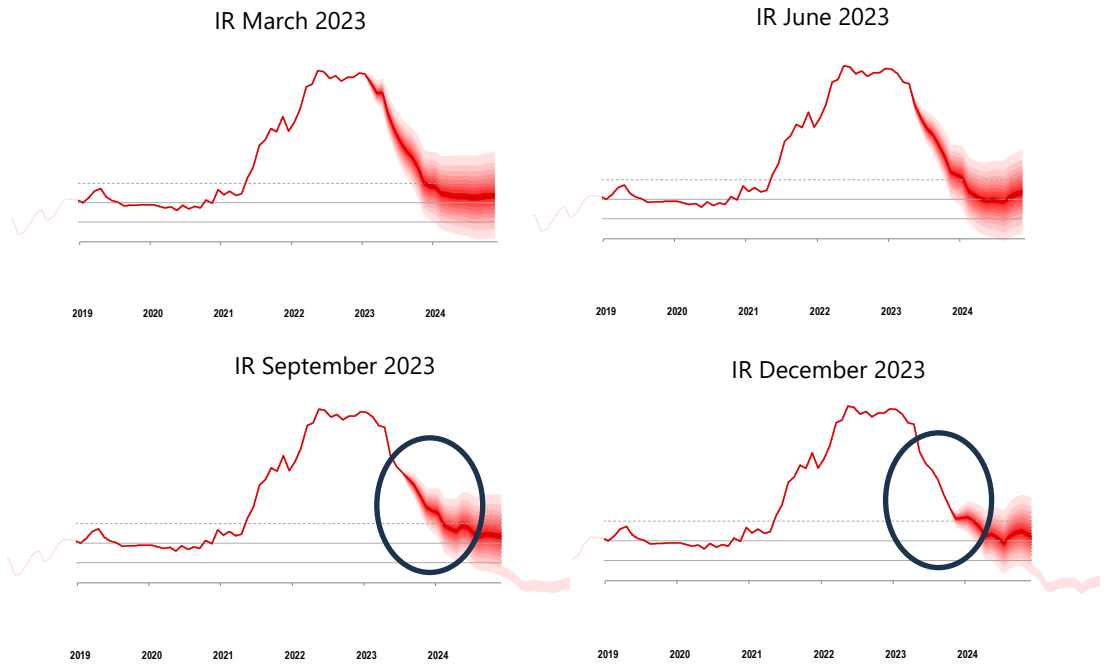
[9] Prepared by Luis Zapata.

[10] The first notable floods started by the end of March 2023.

By the June 2023 report, the picture had begun to change. The end-of-year inflation forecast was revised upwards to 3.3%, explicitly due to the "effect of adverse climatic events". The upside bias in the balance of risks increased, driven by a larger expected impact from "food and energy price shock".

Changes to the fan chart of inflation in 2023

Graph B5



Notes: Inflation projection fan charts (year-on-year, %), IR = Inflation Report.

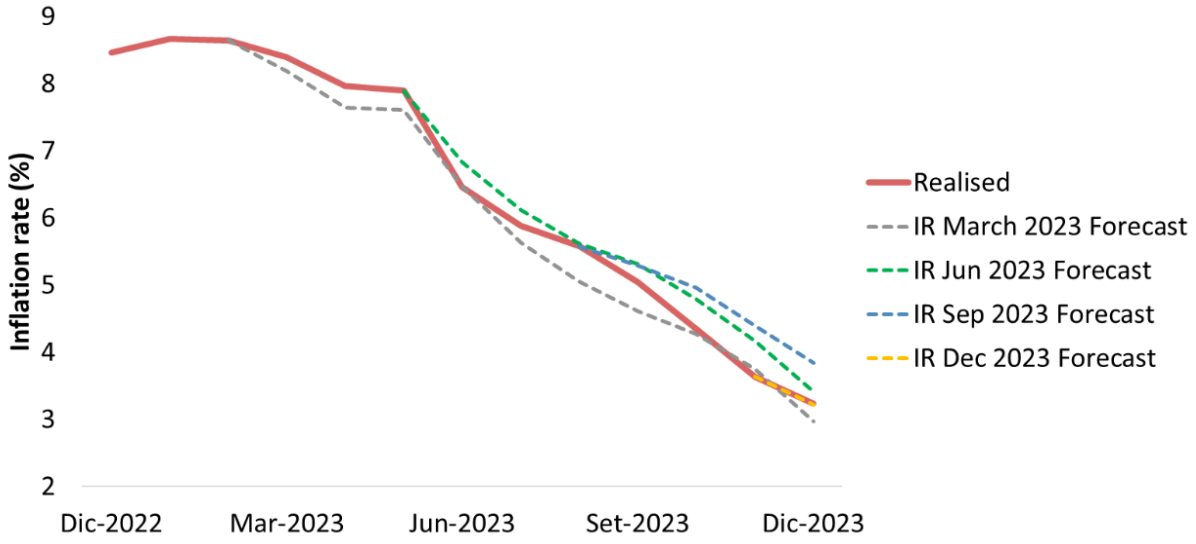
The September 2023 report marked an increasing turning point (see Graph B5). The BCRP made a significant downward revision to its 2023 GDP growth forecast, from 2.2% in June to just 0.9%. The report's wording explicitly acknowledged the surprise, stating that the supply shocks "had a greater than anticipated impact". The FEN was no longer a background risk; the baseline scenario was updated to assume a "moderate" FEN, with with communications from the Multisectoral Commission for the National Study of the El Niño Phenomenon (Comisión Multisectorial encargada del Estudio Nacional del Fenómeno El Niño, ENFEN)" communications now considering a "moderate to strong" event to be almost certain. The primary upside risk to the inflation projection was now clearly identified as a potential "strong or severe FEN event in the summer of 2024".

The December 2023 report presented the final diagnosis of the year's shocks. The 2023 GDP forecast was revised down again to a contraction of 0.5%. The report's box 1, "Shocks that affected the Peruvian economy in 2023" quantified the magnitude of the surprise. It estimated that the series of shocks subtracted a total of 2.7 percentage points from GDP growth. The FEN alone was responsible for a –1.1 percentage point impact, making it the single largest shock of the year. The balance of risks for the inflation projection noted a reduced upside bias compared with September, but the primary risk remained the potential for a strong FEN in early 2024.

This episode demonstrates how the BCRP's analytical framework is designed not for perfect foresight but for adaptation (see Graph B6). The sequential changes in the balance of risks, the fan charts and the official wording of the reports allowed the BCRP to transparently communicate its evolving assessment of the economy, providing a clear rationale for its policy decisions in a period of significant and unexpected disruption.

Realised inflation and baseline forecasts of inflation during 2023

Graph B6

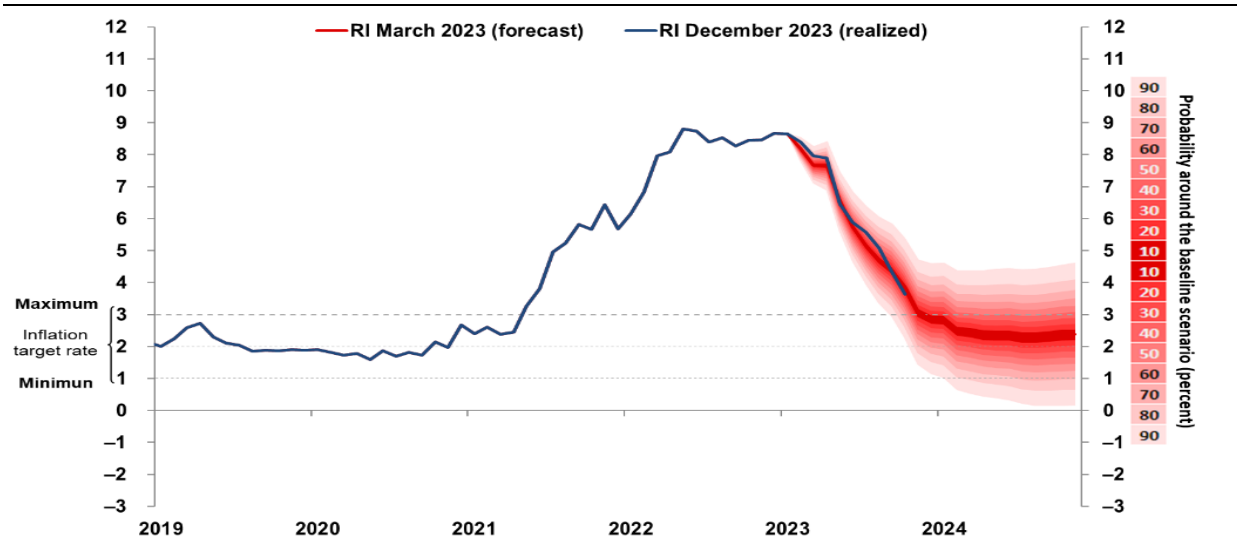


Note: IR = Inflation Report

While the observed inflation at the close of 2023 ultimately aligned with the initial annual forecast, the projection itself was subject to volatility throughout the year. Inflation was sometimes higher than expected (particularly in September) due to inflationary pressures stemming from a greater-than-anticipated impact of El Niño, which necessitated mid-year forecast revisions (see Graph B7).

Realised inflation in 2023 and 2023 March Inflation Report fan chart

Graph B7



3.1 Measuring uncertainty with the core model

The MPT is a semi-structural model and serves as the core of the forecasting framework (see Box 4). This model framework ensures the coherence of the initial point, different forecasts of exogenous variables, estimation of unobservable variables and expert judgment.

Given its important role, the MPT is designed to be versatile and flexible, capturing various forms of structural uncertainty, such as: (i) the nature of shocks (whether they are temporary or persistent, and whether they disrupt other model relationships); (ii) parameter uncertainty (for example, the slope of the Phillips curve or the degree of inertia in expectations); and (iii) model misspecification (such as linearity versus nonlinearity or the omission of mechanisms like occasionally binding constraints).

For instance, adjustments have been made to the MPT to account for shifts in Phillips curve inertia, changes in expectation dynamics and the introduction of a two-stage treatment for unanticipated shocks. These modifications ensure that the model remains relevant as the nature of shocks evolve. Therefore, alternative central scenarios are generated under coherent changes to the model's framework, maintaining internal consistency. For example, to simulate a risk scenario that captures the non-linear and state-dependent behaviour of inflation during a period of high inflation within the MPT framework, the modelling strategy consisted of increasing the inertia parameters for the persistence of core inflation and inflation expectations. To ensure rigour, the calibration exercise set the persistence parameters in the Phillips curve and the inflation expectation formation equation to the upper bound of the estimated parameter range (the 90% confidence interval), as reported in Aguirre et al (2023).

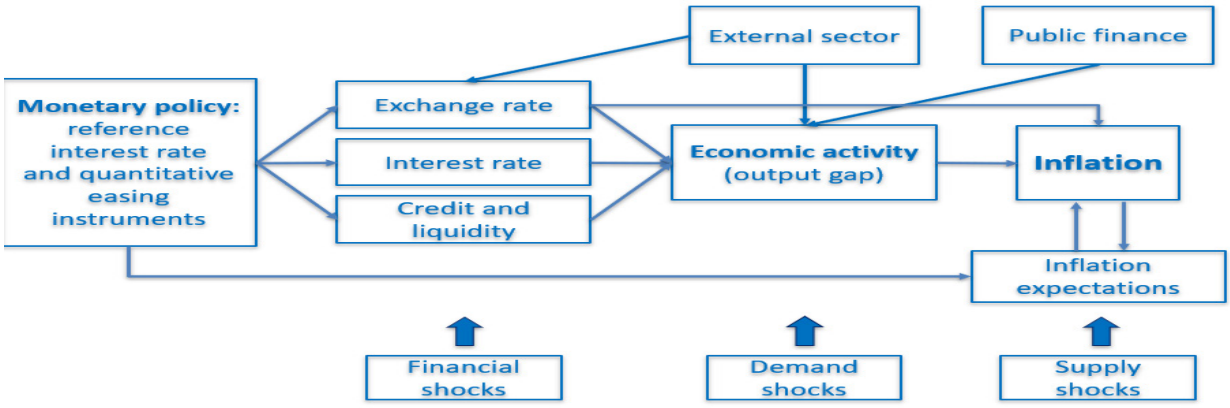
Further, by systematically altering exogenous assumptions and shock paths within the MPT, the BCRP can quantify their effects on inflation and economic activity. This process adds discipline and coherence to forecasting and strengthens the assessment of uncertainty. For example, economic and policy uncertainty plays a critical role in shaping business investment and confidence, which in turn influences overall economic growth. Private investment, in particular, is closely linked to business confidence (see Graph 4). Moreover, there is a strong correlation between non-residential investment, and the two-quarter lagged value of the business confidence index. During periods of heightened domestic or external uncertainty, shocks to business confidence weaken aggregate demand and exert downward pressure on inflation. To capture these dynamics, the MPT framework accommodates confidence shocks by adjusting their projected paths and their impact on future aggregate demand. The judgment of the staff about the duration and intensity of these shocks are disciplined by the structure of the MPT, ensuring coherence in both baseline and risk scenario forecasts.

Box 4

The BCRP Quarterly Projection Model[11]

The Quarterly Projection Model (QPM or MPT in Spanish) is one of the models that the Central Reserve Bank of Peru (BCRP) uses to monitor the economy and prepare projections. It is a semi-structural model, inspired by the New Keynesian tradition, which combines theoretical models with micro foundations and the flexibility of empirical approaches. This versatility allows it to capture relevant mechanisms for monetary policy and adapt to changes in the economic environment. Various versions of the QPM have been documented by Vega et al (2009), Winkelried (2013) and Aguirre et al (2023). A simplified version of its main characteristics is presented in Graph B8.

Determinants of inflation and monetary policy transmission mechanisms — Graph B8



Source: Inflation Report BCRP 2023.

Main relationships

- Inflation

$$\pi_t = c_{sae}\pi_t^{sae} + (1 - c_{sae})\pi_t^{ae}$$

In the QPM, inflation (π_t) is divided into the inflation excluding food and energy(π_t^{sae}), as the trend measure, and the food and energy inflation (π_t^{ae}) , which is more volatile.

The inflation excluding food and energy (π_t^{sae}) follows a Phillips curve for an open economy that incorporates imported inflation in soles, an inertial component, four-quarter-ahead expectations, and the output gap.

$$\pi_t^{sae} = b_m\Pi_t^m + (1 - b_m)[b_{sae}\pi_{t-1}^{sae} + (1 - b_{sae})\Pi_t^e] + b_y[c_y y_t + (1 - c_y)y_{t-1}] + \varepsilon_t$$

In this way, trend inflation is determined by three main forces: the pass-through of the exchange rate and international prices, the impact of the output gap on costs and margins, and the role of expectations, which can amplify shocks or help anchor them.

The food and energy inflation (π_t^{ae}) reflects transitory supply shocks with inertial persistence.

$$\pi_t^{ae} = \rho_{\pi_t^{ae}}\pi_{t-1}^{ae} + (1 - \rho_{\pi_t^{ae}})[b_s\pi_t^{sae} + (1 - b_s)\pi_t^m] + \varepsilon_t$$

Its dynamics depend on domestic inflation inertia itself, four-quarter-ahead expectations, and changes in external relative import prices. Thus, it reflects an incomplete and persistent exchange rate pass-through, associated with nominal rigidities and market segmentation. Given its predominantly transitory nature, more volatile inflation usually arises from supply shocks which, in general, do not require monetary policy responses.

[11] Prepared by Luis Yepez.

- Output gap

$$y_t = a_{y^e}[y_{t-1} + x^e_{t+1}] + a_y y_{t-1} - a_\psi \psi_{t-1} + a_{\tau^{px}} \tau^{px}_t - a_{\tau^{pi}} \tau^{pi}_t + a_q q_t + a_{y^*} y^*_t - a_t t_t + a_g g_t + \varepsilon_t$$

The output gap (y_t) is modelled with an demand curve structure for open economies, where activity responds to both domestic and external factors. Its dynamics are explained by expectations about future developments, its lags, financial conditions summarised in the Real Monetary Conditions Index (RMCI), the real exchange rate gap as a measure of external competitiveness, and the activity of trading partners. The model also separates the effects of export and import prices and distinguishes between fiscal shocks from spending and revenue, which allows the estimation of specific multipliers and a more precise measurement of how different shocks – domestic or external – are transmitted to the economy.

- The monetary policy rule

$$i_t = \rho_i i_{t-1} + (1 - \rho_i)[i^n_t + f_\pi \, \hat{\Pi}^e{}_{t+4} + f_y\big[c_{fy} y_t + \big(1 - c_{fy}\big) y_{t-1}\big] + \varepsilon_t$$

The monetary policy rule (i_t) is forward-looking: the policy rate responds to the deviation of expected inflation, excluding food and energy, four quarters ahead from the target, as well as to the current and lagged output gap. It is calibrated relative to the natural interest rate, which allows evaluating the monetary stance, and incorporates an inertial component that moderates the adjustment pace to avoid abrupt changes that could generate financial instability or excessive volatility.

- Real Monetary Conditions Index (RMCI)

$$\psi_t = c_{rmn} r^{mn}_t + c_{rme} r^{me}_t$$

The RMCI (ψ_t) summarises the impact of financial conditions on aggregate demand. It combines the gaps of domestic and foreign interest rates in soles, together with the exchange rate risk premium, which reflects the effects of depreciations on agents with foreign currency liabilities, particularly relevant in economies with dollarisation and currency mismatches. A tightening of financial conditions – whether through higher real interest rates or an increase in the risk premium – makes financing more expensive and restricts consumption and investment, reducing economic activity; weaker financial pressures generate the opposite effect.

- Fiscal sector

$$t_t = \rho_t t_{t-1} + \varepsilon_t$$
$$g_t = \rho_g g_{t-1} + \varepsilon_t$$

The model distinguishes between the fiscal shock from public spending (g_t) and from tax revenue (t_t), which allows for the estimation of specific multipliers instead of assuming a single net fiscal shock. This disaggregation provides a more precise view of the impact of each instrument on aggregate demand: public spending generates a faster stimulus, while tax collection exerts a more gradual contractionary effect.

- External sector and exchange rate determination

$$\tau^{\mathrm{px}}_t = \left(a_{\tau_{\text{largo}}} + a_{\tau_{\text{carto}}}\right) \tau^{\mathrm{px}}_{t-1} - a_{\tau_{\text{largo}}} a_{\tau_{\text{carto}}} \tau^{\mathrm{px}}_{t-2} + \left(a_{\tau_{\text{largo}}} - a_{\tau_{\text{corto}}}\right) \frac{\pi^{x\$}_t - \pi^*}{4} + \varepsilon^{\mathrm{pc}}_t$$
$$\tau^{\mathrm{pi}}_t = \left(a_{\tau_{\text{largo}}} + a_{\tau_{\text{carto}}}\right) \tau^{\mathrm{pi}}_{t-1} - a_{\tau_{\text{largo}}} a_{\tau_{\text{corto}}} \tau^{\mathrm{pi}}_{t-2} + \left(a_{\tau_{\text{largo}}} - a_{\tau_{\text{carto}}}\right) \frac{\pi^{ms}_t - \pi^*}{4} + \varepsilon^{\mathrm{pi}}_t{}^{\mathrm{pi}}$$

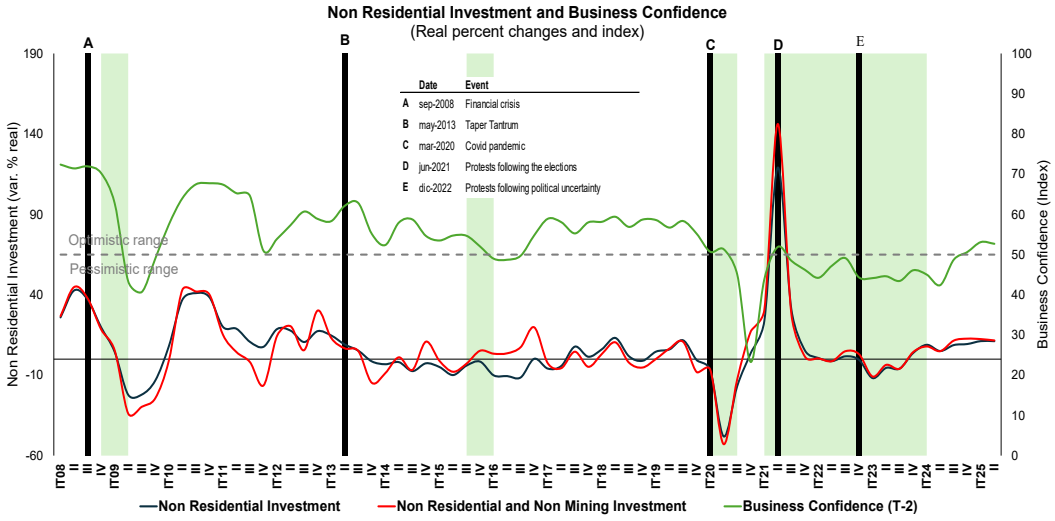
Export $\left(\tau^{px}_t\right)$ and import $\left(\tau^{pi}_t\right)$ prices are modelled as autoregressive processes that capture their persistence and intrinsic dynamics. Imported inflation arises when nominal depreciation or higher international prices make imported goods more expensive, reducing purchasing power. However, nominal rigidities and market segmentation make the exchange rate pass-through incomplete and persistent, extending inflationary pressures well beyond the initial shock. Moreover, an increase in export prices strengthens the external position and stimulates domestic demand.

$$\lambda_t = \rho_\lambda E_t \lambda_{t+1} + (1 + \rho_\lambda)[i^{m\epsilon}_t + \xi_t - i^{mn}_t + \varepsilon_t]$$

Uncovered interest rate parity (λ_t) determines nominal depreciation as a function of expected depreciation, the interest rate differential and a risk premium – composed of country and exchange rate risk – that responds to external shocks and to the evolution of export prices. An increase in export prices strengthens the external position, reduces the risk premium, moderates nominal depreciation and limits exchange rate pass-through to inflation. In this way, parity links external conditions with internal stability, contributing to the reinforcement of both macroeconomic and financial stability.

Private investment and business confidence

Graph 4



Correlations with Business Confidence

	IT. 2008-IVT. 2019	IT. 2008-IT. 2024
Private Investment (T+1)	0,81	0,28
Residential Investment (T)	0,51	0,08
Investment Non Residential (T+2)	0,84	0,38
Investment Non Residential and Non Mining (T+2)	0,74	0,27

[1] Green bars denote periods during which the three-month business confidence index remained in the pessimistic range (below 50).

Sources: BCRP Inflation Reports.

4. Monetary policy decisions and uncertainty

To address data uncertainty, the Board reviews the evolution of various sectoral and granular indicators that relate to key macroeconomic aggregates. For example, to assess inflation trends, the Board examines inflation expectations derived from macroeconomic surveys of financial and non-financial firms, as well as economic analysis. These are reviewed alongside core inflation indicators and the year-on-year variation of the different components of the Consumer Price Index (CPI). A similar approach is taken for evaluating economic activity, using sectoral data to validate broader trends.

As previously discussed, the MPT faces two main sources of uncertainty: statistical and misspecification. The first relates to the possibility that the model fails to capture all underlying relationships between variables – such as nonlinearities – or omits important variables due to data limitations. The second concerns the risk that estimated coefficients deviate from their true values, as they are derived from limited historical data. In light of these limitations, sensitivity scenarios are developed to evaluate how monetary policy should respond to different macroeconomic conditions and projections.

Additionally, to support the process of monetary policy decisions under uncertainty, the forecasting framework incorporates simulations of alternative policy scenarios. These simulations begin with a set of baseline assumptions and explore how different policy responses might influence macroeconomic outcomes. This approach allows the Board to assess the robustness of their decisions and anticipate potential trade-offs.

A common reference point in these simulations is the Taylor rule, which provides a systematic guideline for setting the policy interest rate based on deviations of inflation from its target and output from its potential. Deviations from the Taylor rule are explicitly modelled to evaluate their implications for inflation, output and financial stability.

Policy scenarios can also account for potential nonlinearities in the economy, which can significantly alter the effectiveness of policy responses. These can include deviations from the uncovered interest parity condition, reflecting shifts in investor sentiment as well as changes in country risk or external shocks. These factors help to assess the impact of exchange rate dynamics on inflation and monetary transmission. They also include high- versus low-inflation regimes, to account for adjustments in expectations and potentially greater persistence in core inflation, as well as negative interest rate differentials, when domestic interest rates fall below external rates, which may weaken the transmission of monetary policy.

5. Monetary policy in times of high uncertainty: flexibility, predictability and communication

During periods of heightened volatility, the formulation of monetary policy decisions involves a complex set of considerations. A primary requirement is that the Board operates based on a comprehensive information set, supported by analytical models capable of generating alternative policy paths and delineating uncertainty bounds. This modelling framework is complemented by expert judgment and insights drawn from international experience, thereby enhancing the robustness and credibility of the decision-making process.

This analytical foundation is inseparable from the communication strategy and the challenges that uncertainty imposes on it. The BCRP is characterised by a data-dependent approach to policy decisions, which provides greater flexibility. Consistent with this approach, the Bank's forward guidance has traditionally been qualitative, avoiding explicit thresholds for changes in the policy stance.[12] Monetary policy statements, however, include reference projections regarding the convergence of inflation towards the target range – typically around the midpoint – without specifying a precise horizon.

[12] See Contreras (2014). Herrada et al (2020) include summaries of forward guidance practices in South America. According to Evdokimova et al (2023), the practice of qualitative forward guidance is common among emerging market economy central banks and reflects the need for flexibility under high volatility.

A key feature of this qualitative guidance is the inclusion of a paragraph in the monetary policy statement in which the Board commits to remaining vigilant and taking all necessary measures to achieve its price stability objective. This formulation compensates for the absence of explicit commitments on the future path of the policy rate by reinforcing the credibility of the inflation target.

This strategy – emphasising inflation projections while refraining from explicit statements on the policy rate path – has proved effective in anchoring expectations and maintaining price stability. The rationale for this approach is closely linked to Peru's monetary policy experience during major global crises. Unlike central banks in advanced economies, which reached the zero lower bound during the Great Financial Crisis and resorted to quantitative easing and explicit forward guidance, the BCRP stabilised the economy using instruments familiar to the market. These included policy rate reductions, adjustments to reserve requirements, liquidity provision through repos and foreign exchange interventions.

It was only during the Covid-19 crisis in 2020 that the policy rate reached 0.25%, a situation that proved short-lived. Inflation that year stood at 1.97%, close to the 2% midpoint of the target range. This outcome reinforced the effectiveness of the existing framework and validated a communication strategy aligned with pre-global crisis norms – one that prioritises flexibility, clarity and a strong commitment to the inflation target without reliance on explicit numerical guidance.

5.1 Communicating uncertainty

The BCRP communicates uncertainty mainly through its Inflation Report, which is published quarterly. In this report, the BCRP presents a baseline macroeconomic scenario together with fan charts for inflation and GDP growth, which explicitly show the probability distribution of future outcomes. By doing so, the BCRP acknowledges the uncertainty around its projections and highlights that actual results may differ depending on domestic and external shocks.

Additionally, monetary policy statements, press releases and other publications often emphasise the balance of risks surrounding the inflation forecast, identifying upside and downside risks such as commodity price volatility, capital flow reversals or domestic supply shocks. This combination of quantitative tools (fan charts) and qualitative assessments (risk balance discussion) allows the BCRP to clearly express to markets and the public that monetary policy decisions are made under uncertainty. This analysis is made in each process of monetary policy decision-making.

The BCRP applies qualitative guidance in its monetary policy decision statements. They are characterised by not explicitly mentioning projections of the reference interest rate. Examples of BCRP communications include the following statements:

- *"Future reference rate adjustments will be conditional on new information about inflation and its determinants"* (August 2025).
- *"The Board is particularly attentive to new information on inflation and its determinants, including the evolution of core inflation, inflation expectations, and economic activity, to consider, if necessary, changes in the monetary stance. The Board reaffirms its commitment to adopt the necessary actions to maintain inflation within the target range"* (September 2025).

Examples during turning points (starting to raise or lower the policy rate):

- *"The Board considers it appropriate to maintain an expansionary stance as long as the negative effects of the pandemic on inflation and its determinants persist and is especially attentive to new information referring to inflation expectations and the evolution of economic activity to consider, if necessary, changes in the monetary policy position. The BCRP will continue to take the necessary steps to sustain the payments system and credit flows. Financial markets were highly volatile in a context of uncertainty and the BCRP's actions were intended to mitigate this volatility"* (August 2021).
- *"This decision does not necessarily imply a sequence of interest rate reductions. Future reference rate adjustments will be conditional on new information about inflation and its determinants"* (September 2023).
- *"The Board is particularly attentive to new information on inflation and its determinants, including the evolution of inflation expectations and economic activity, to consider, if necessary, additional changes in the monetary stance. The Board reaffirms its commitment to adopt the necessary actions to ensure the return of inflation to the target range over the forecast horizon"* (September 2023).

With respect to communication on uncertainty, monetary policy statements include, when appropriate, a paragraph on risks arising from different events that generate uncertainty. Examples of such paragraphs include:

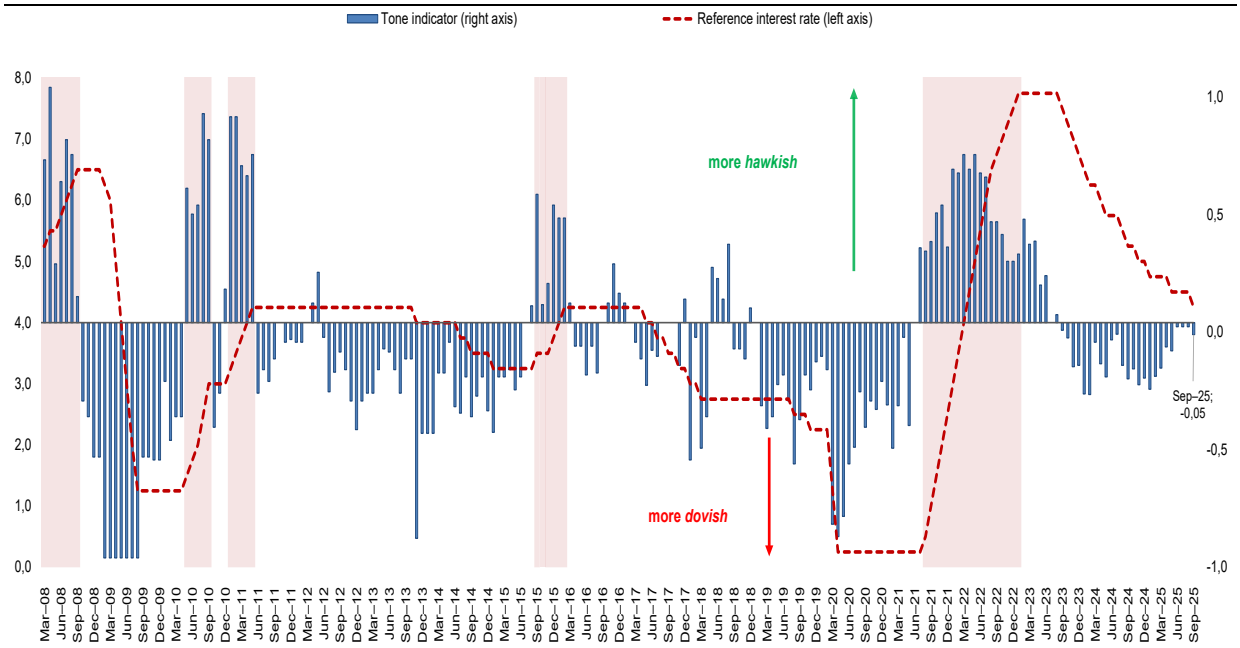
- *"The outlook for global economic activity continues to be affected by the restrictive measures on international trade, with a downward bias in the medium term given the high uncertainty about its effects on the global economy"* (September 2025).
- *"The outlook for global economic activity points to moderate growth as a gradual monetary policy normalization continues in most advanced economies. Uncertainty persists regarding the impact of trade policies, as well as the risks arising from international conflicts"* (January 2025).

Additionally, in each quarterly Inflation Report, the BCRP publishes a section that explains its decision-making process. This communication strategy seeks to reinforce the reasoning behind its decisions. It also includes the Monetary Policy Tone Indicator (Graph 5), where policy statements are assessed as hawkish, dovish or neutral. This index captures signals of changes in the BCRP's stance by considering actual data, outlook, expectations and the international context within which concerns about uncertainty are incorporated. The frequency of estimation of this index is aligned with the monetary policy decision process and the publication of the monetary policy statement.

Other indices more closely related to uncertainty that are analysed in the BCRP's decision-making process are the Trade Policy Uncertainty Index (TPU Index based on Caldara et al (2020)) (Graph 6) and the Cboe Volatility Index (VIX) (Graph 7). While these indices are representative of the international context, they are useful in assessing monetary conditions and how they might affect Peru, given that it is an economy exposed to external shocks.

Reference interest rate and monetary policy tone indicator*

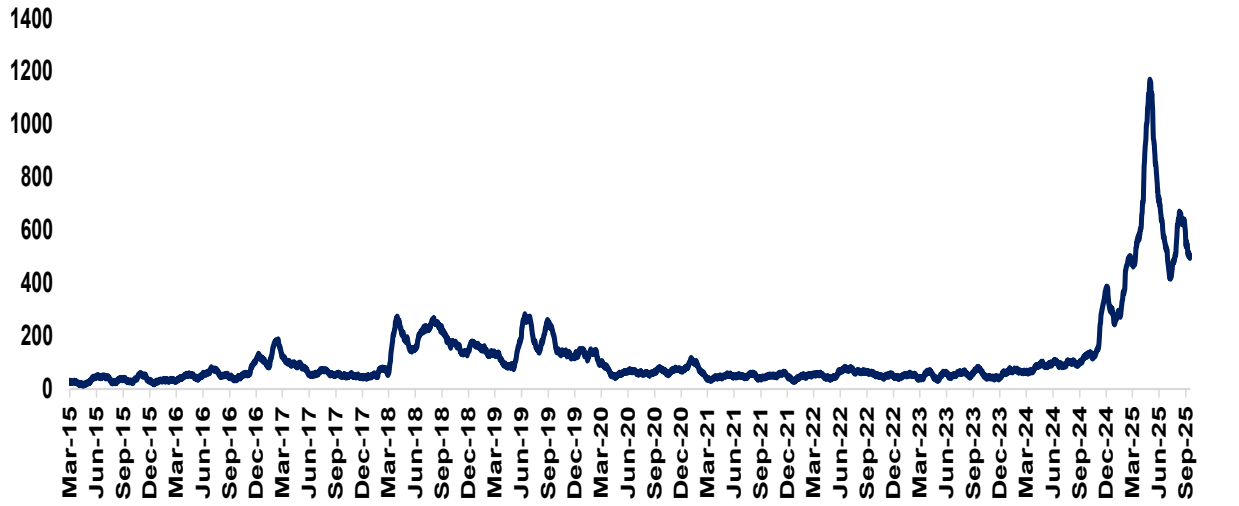
Percentage and index value — Graph 5



* For the monetary policy tone indicator, positive index values indicate a tone in favour of a contractionary stance, while negative values imply communication with an expansionary stance. The light red shaded areas correspond to periods of interest rate hikes.

Trade Policy Uncertainty Index (TPU Index)*

30-day moving average of the index at daily frequency — Graph 6



* As of 15 September 2025.

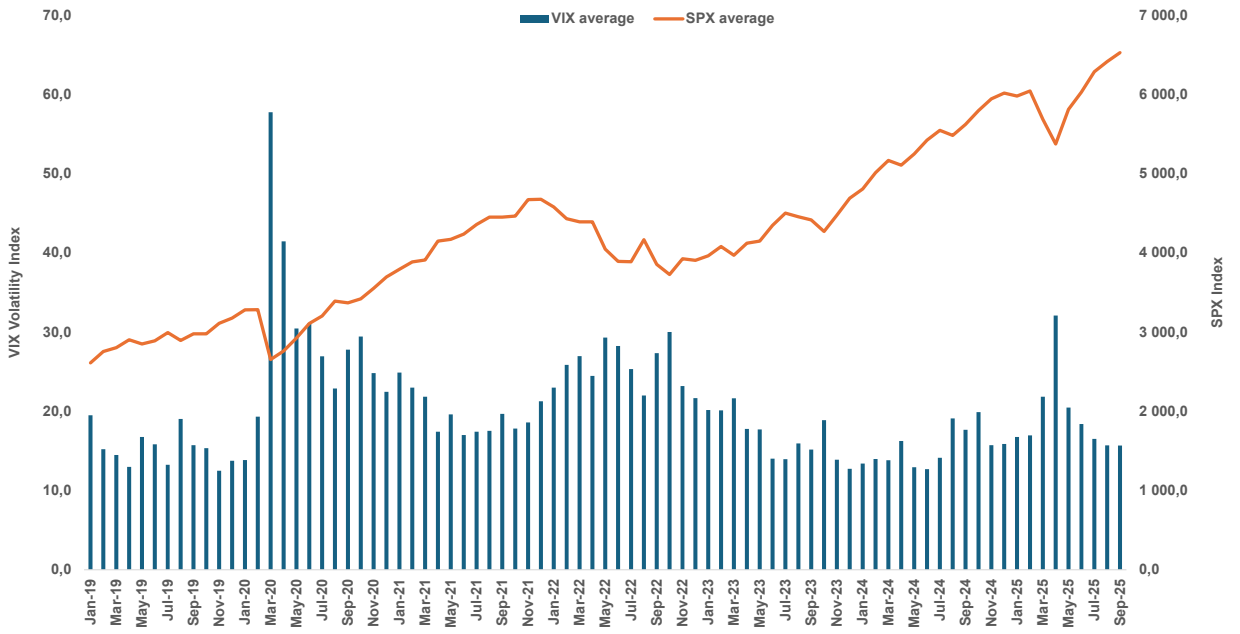
Source: Caldara et al (2020).

Retrieved from matteoiacoviello.com/tpu_files/tpu_web_latest.xlsx.

Cboe Volatility Index (VIX) and the US stock market (S&P 500)*

Monthly average

Graph 7



* As of 17 September 2025.

Source: Bloomberg.

5.2 Communicating alternative scenarios

Alternative scenarios are highly useful for the BCRP, as the Peruvian economy is particularly exposed to external shocks (eg commodity prices, global financial conditions) and domestic supply shocks (eg climate events such as El Niño). By presenting alternative scenarios, the BCRP helps market participants and the public understand how monetary policy could respond under different conditions, thereby strengthening the credibility of its mandate to maintain price stability. For instance, scenarios that consider higher commodity prices, more restrictive global financial conditions or stronger-than-expected domestic demand allow the BCRP to illustrate the potential impact on inflation and output, and explain how its policy stance might adjust. This not only improves the transparency of monetary policy but also manages expectations by showing that the BCRP has a systematic framework to respond to different shocks.

In the quarterly Inflation Report, scenarios are presented in various ways. There is a baseline projection scenario over the horizon that is established by the report across all sectors (external, balance of payments, real sector, fiscal sector and monetary sector). Additionally, for some variables such as inflation and output, fan charts are shown to illustrate the probability that the outcomes of these variables will differ from the baseline scenario. Finally, in the risk balance, the potential impact of certain shocks on inflation over the projection horizon is presented. Therefore, the

presentation of these scenarios reinforces the BCRP's commitment to act under different circumstances, which supports the monetary policy communication process.

6. Conclusions

The BCRP's risk management strategy is designed to enhance the pass-through of the policy rate across the financial system and mitigate risks associated with financial dollarisation. By employing a hybrid approach that combines the benchmark rate with other monetary policy instruments, such as injection and sterilisation operations, reserve requirements and foreign exchange market interventions, the BCRP ensures market functioning and reduces excessive volatility.

The BCRP's monetary policy framework is designed to be flexible and adaptable to a dynamic and evolving economic environment. This adaptability is supported by an integrated macroeconomic forecasting system that continuously refines the policy stance based on new information.

The BCRP's success in managing monetary policy is contingent upon effective risk assessment and the ability to navigate various sources of uncertainty. This involves evaluating potential economic scenarios and incorporating expert judgment into policy design and implementation

Finally, the BCRP's communication strategy, which includes the use of fan charts and qualitative assessments of risks in its Inflation Report, plays a crucial role in helping markets and the public understand the possible direction of future monetary policy.

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Communication as policy and firm uncertainty: evidence from randomised control trial

Okan Akarsu[*], Fatih Karahan[+] and Huzeyfe Torun[§]

Abstract

This paper uses a randomised controlled trial (RCT) to investigate whether central bank communication – the delivery of publicly available signals – affects firms' perceptions of uncertainty regarding inflation expectations, the economic outlook and forecast difficulty. The RCT assigns firms to one of four information treatments: professional 12-month CPI forecasts, the Central Bank of the Republic of Türkiye's (CBRT) current-year projection, the next-year projection, or the medium-term inflation target, or to a control group. We first show that higher uncertainty is strongly associated with weaker sales and employment plans, tighter anticipated financial conditions, and higher wage and cost expectations. Second, using a compact three-point elicitation (minimum-mode-maximum) mapped to a triangular posterior, we measure both the level and dispersion of inflation expectations and show that the communication treatments significantly compress dispersion in inflation expectations. Finally, we show that information treatments reduce within-firm subjective uncertainty regarding the future economic outlook and mitigate firms' perceived forecasting difficulty, with effects persisting for up to two months before attenuating. Taken together, the results indicate that central bank communication can meaningfully anchor firms' beliefs and improve sentiment, but the effects decay without reinforcement. Effective communication therefore requires periodic, state-contingent updates coordinated across reports, speeches and data releases.

Keywords: expectations, uncertainty, high inflation, randomised controlled trial, macroeconomics

JEL classifications: E12; E24; E31; E52

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1. Introduction

How firms form and update their expectations is central to the transmission of monetary policy and the dynamics of inflation. Uncertainty about the future path of inflation is a key friction in economic decision-making, as beliefs about future prices and costs move current decisions on wage setting, investment and pricing. When firms are unsure about future prices and costs, they may delay investment, hesitate to hire and adopt precautionary pricing strategies, weakening the transmission of monetary policy (Bloom (2009)). While central banks devote considerable resources to anchoring the level of inflation expectations, a distinct and equally critical challenge is managing the uncertainty surrounding those beliefs. This paper uses a randomised controlled trial (RCT) experiment to investigate whether the delivery of publicly available signals affects firms' perception of uncertainty regarding inflation expectations, economic outlook and forecast difficulty. Credible public signals can shape firms' beliefs and near-term outlooks. As expectations are heterogeneous, subject to persistent disagreement, and shaped by limited attention and noisy signals,[1] these frictions can amplify macroeconomic shocks and weaken policy pass-through. Consequently, central bank communication strategies aim not only to anchor the level of expectations but also to reduce the uncertainty surrounding them.

Beyond mean beliefs, the *second moment* of expectations has first-order implications for behaviour. A foundational insight from the real options tradition is that uncertainty induces firms to delay irreversible choices, such as investment and hiring (Bernanke (1983)). This "wait-and-see" mechanism has been shown to account for sharp, synchronised downturns during uncertainty spikes (Bloom (2009, 2014)). A large literature documents multiple sources of uncertainty: firm-specific uncertainty about future business conditions (Bloom et al (2007); Bachmann et al (2013); Bachmann et al (2017); Fiori and Scoccianti (2023)); aggregate macroeconomic uncertainty (Bloom (2009); Popescu and Smets (2010); Bachmann and Bayer (2014); Jurado et al (2015); Cesa-Bianchi et al (2020); Altig et al (2020)); financial market volatility (Gilchrist et al (2014); Christiano et al (2014); Caggiano et al (2021)); policy uncertainty (Fernández-Villaverde et al (2011); Kang et al (2014); Baker et al (2016); Gulen and Ion (2016); Binding and Dibiasi (2017); Brogaard et al (2020)); and demand uncertainty and consumer confidence (Arellano et al (2010); Barsky and Sims (2012)). Our paper bridges two core areas of this literature: (i) expectation formation under information frictions; and (ii) the pricing consequences of uncertainty for firms.

Building on Akarsu et al (2025), which used an experimental design to show that information treatments can shift the level of inflation expectations and influence firms' decisions, this paper asks a distinct question: can central bank communication also compress belief dispersion and reduce various measures of perceived uncertainty? To investigate the second moment of inflation expectations, we employ a three-point elicitation (minimum-mode-maximum) for 12-month-ahead inflation. Interpreting this triplet as a triangular posterior allows us to derive a firm-specific measure of subjective uncertainty in inflation expectations. We complement this primary measure with two survey-based indicators of economic uncertainty to provide a comprehensive picture of firms' perceived uncertainty: (i) a firm-level uncertainty index constructed from forward-looking business tendency survey (BTS)

[1] See Mankiw and Reis (2002); Sims (2003); Coibion and Gorodnichenko (2012) for the literature on information frictions.

items (Bachmann et al (2013)); and (ii) a direct self-assessment of forecasting difficulty.

We have several findings. Before making causal use of the RCT, we highlight the strong association between high inflation expectations and weaker sales and employment plans, tighter anticipated financial conditions, and higher wage and cost expectations. This pattern can be interpreted as evidence of an expectations channel through which information frictions transmit to real and pricing decisions (Bloom (2009); Gilchrist et al (2014)). Second, we examine the second moment of expectations. Using a compact three-point elicitation (minimum-mode-maximum) mapped to a triangular posterior, we measure the dispersion of inflation expectations and show that the communication treatments significantly compress this dispersion. We also find that information treatments reduce (i) the within-firm disagreement index regarding the future economic outlook, constructed from forward-looking BTS items (Bachmann et al (2013)); and (ii) firms' direct self-assessment of forecasting difficulty. Exploiting the panel dimension of the data, we finally show that the impact persists for up to two months before attenuating. This temporal profile is consistent with sticky information and rational inattention frameworks, in which salient, low-cost signals trigger sharp updates that gradually decay as attention reallocates and new shocks arrive (Mankiw and Reis (2002); Sims (2003)).

Overall, the results indicate that central bank communication can function as a policy instrument for managing uncertainty. Guidance that is concrete and state-contingent compresses disagreement and improves the near-term tone, but the effects decay quickly. Hence, one-off announcements are insufficient for durable anchoring. Communication must be refreshed at a frequency consistent with the observed attenuation of effects, coordinated across reports, speeches and data releases, and supported by simple monitoring of key indicators such as disagreement and forecasting difficulty to guide reinforcements. The remainder of the paper proceeds as follows. Section 2 sets out the institutional background and recent inflation dynamics. Section 3 describes the sample, timing, randomised information treatments (post-May 2024 BTS), and belief-elicitation and uncertainty measures. Section 4 presents the experimental results and their persistence, showing sharp uncertainty reductions that fade within two months, interpreted through sticky information and rational inattention frameworks. Section 5 concludes with policy implications for cadence-aware, state-contingent communication.

2. Inflation dynamics in Türkiye

Graph 1 illustrates the evolution of monthly firm inflation expectations alongside the realised annual change in the Consumer Price Index (CPI) in Türkiye. Beginning in 2017, the economy entered a sustained phase of high inflation. Although the monetary tightening cycle in mid-2018 temporarily reduced demand-driven pressures, subsequent shocks pushed inflation dynamics onto a more volatile path. The outbreak of the Covid-19 pandemic in 2020, followed by a series of interest rate cuts starting in September 2021, culminated in an unprecedented inflation peak by October 2022. In the summer of 2023, the Central Bank of the Republic of Türkiye (CBRT) initiated a decisive tightening cycle, raising the policy rate from 8.5% to 50% by March 2024. Coupled with fiscal consolidation, these measures contributed to exchange rate stabilisation and a gradual cooling of domestic demand. As a result,

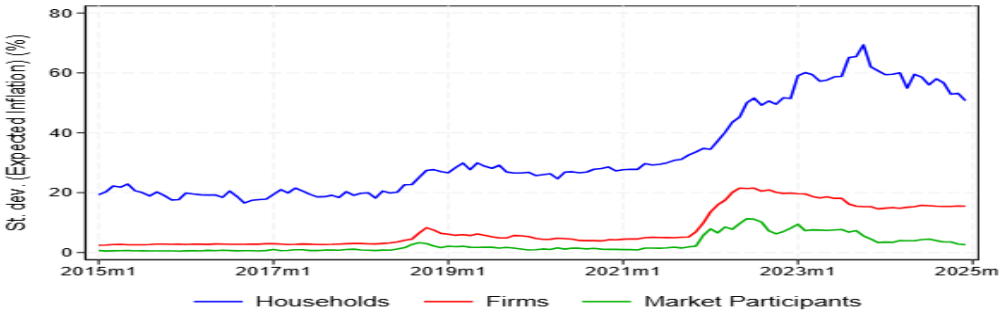
Türkiye entered a disinflationary period beginning in mid-2024 (Akarsu and Aktuğ (2025)).

One-year-ahead inflation expectations of households, firms and professionals

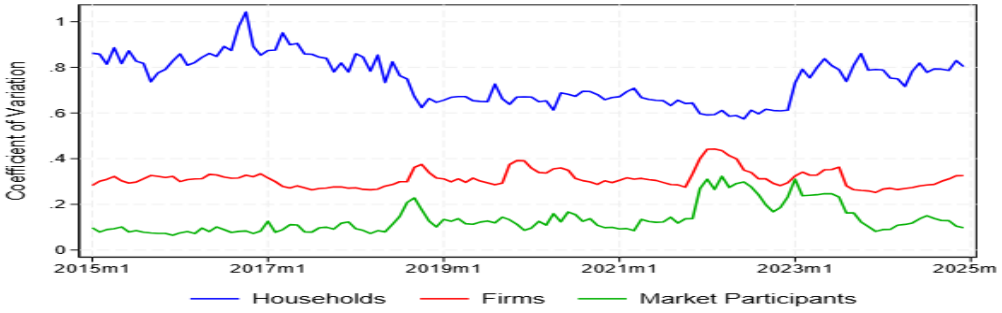
Graph 1

A. Mean expected inflation

B. Disagreement in expected inflation



C. Coefficient of variation of expected inflation



Source: CBRT.

The expectations data across economic agents, presented in Graph 1, reveal that the surge and subsequent decline in inflation were mirrored by substantial shifts in the level, dispersion and relative uncertainty of inflation beliefs. Graph 1.A shows that households consistently reported much higher expected inflation than both firms and market participants, with the divergence widening during the 2021–22 inflation surge. Firms' expectations rose as well, though they remained closer to realised CPI dynamics, while market participants' forecasts stayed the most anchored to actual outcomes. Graphs 1.B and 1.C highlight that disagreement and relative uncertainty, proxied by the cross-sectional standard deviation and the coefficient of variation, were persistently higher for households, moderate for firms and lowest for market participants.

Anchored inflation expectations – stable, target-aligned and resilient to shocks – are typically observed in low-inflation environments (Bernanke (2007); Draghi (2014); Dovern et al (2012)). However, as inflation accelerates, anchors weaken and heterogeneity across agents emerges. Consistent with international evidence, firms in Türkiye revised their expectations heterogeneously during the high-inflation phase: some re-anchored at elevated levels, while others struggled to adjust under heightened uncertainty. As the disinflation episode began in mid-2024, both uncertainty and disagreement declined. This re-anchoring process underscores the importance of credible and consistent monetary policy communication, particularly during volatile periods when inflationary shocks threaten to unmoor expectations.

3. Survey design and information treatments

This section describes the sampling frame, the information-provision experiment and our belief measures. Importantly, we use the very same randomised information experiment in Akarsu et al (2025). Our contribution is to extend the analysis to additional outcomes and mechanisms.

3.1. Measuring inflation uncertainty

We measure perceived inflation uncertainty using the CBRT's firm survey and randomised information design documented in Akarsu et al (2025). Following the May 2024 business tendency survey (BTS), the randomised controlled trial (RCT) began two days later with a seven-day completion window and voluntary participation. We obtained responses from 1,400 firms (a response rate of approximately 65%), and the realised sample is representative of national manufacturing. Firms were randomly assigned to four information sub-groups and a control group. Treatments consisted exclusively of publicly available information – forecasts from professionals and the CBRT – shown immediately before belief elicitation. This design induces exogenous variation in beliefs and permits causal analysis of the impact of communication on perceived uncertainty. Akarsu et al (2025) provides the survey platform, administration details and randomisation protocol that we follow here without modification.

Immediately following the information treatments (or, for the control group, after an equivalent screen), all respondents were presented with a compact three-point distributional elicitation that allows us to measure both the level and dispersion of their inflation expectations for the next twelve months. The precise wording and format presented to firms is shown below:

What is your expectation for the Consumer Price Index (CPI) inflation rate at the end of the next 12 months? In other words, how much do you think the general level of consumer prices will increase over the next 12 months? Additionally, what are your lowest (most optimistic) and highest (most pessimistic) inflation rate estimates at the end of the next 12 months?
At the end of the next 12 months, my annual (CPI) inflation estimate is: .....
My lowest (most optimistic) inflation (CPI) estimate is: .....
My highest (most pessimistic) inflation (CPI) estimate is: .....

These questions allow us to recover both the first moment of expectations and an internally consistent measure of dispersion. Following the literature on compact distributional elicitations, we treat the optimistic, best and pessimistic points as the *min* (a), *mode* (m) and *max* (b) of a triangular distribution and compute posterior moments accordingly. In particular, expected inflation is defined as the mean of the triangular distribution:

$$\pi_i^e = \frac{a_i + m_i + b_i}{3}$$

where π_i^e denotes the subjective distribution of firm i's twelve-month-ahead inflation belief. The associated perceived uncertainty is summarised by the variance of the triangular distribution, given by:

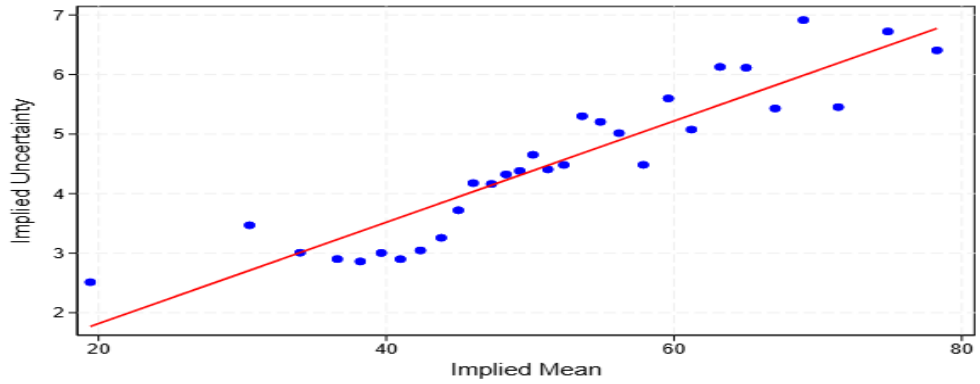
$$Var(\pi_i^e) = \frac{a_i^2 + m_i^2 + b_i^2 - a_i m_i - a_i b_i - m_i b_i}{18}$$

with the standard deviation $SD(\pi_i^e) = \sqrt{Var(\pi_i^e)}$ used as our baseline measure of posterior uncertainty. This formulation captures both the width of the subjective distribution and the degree of centrality of the mode, assigning lower dispersion when m_i lies closer to the centre of $[a_i, b_i]$.

Graph 2 illustrates the empirical relationship between the two measures: firms that report higher implied mean inflation also tend to exhibit systematically greater implied uncertainty, even after controlling for firm characteristics and fixed effects. We compute these measures for all respondents and estimate average treatment effects by comparing posterior uncertainty across randomised treatment groups.

Covariate-adjusted relationship between firms' implied mean inflation and implied uncertainty

Graph 2:



This figure plots the covariate-adjusted binscatter of implied uncertainty against implied mean inflation. The relationship is estimated using the approach of Cattaneo et al (2024), controlling for firm size (employment), firm age, exporter status and leverage, as well as sector and province fixed effects. The red line shows the fitted linear relationship after covariate adjustment.

Source: CBRT.

3.2. Measuring within-firm subjective uncertainty and forecasting difficulty

We use three different measures for firms' subjective uncertainty. Our primary outcome is a firm-month measure of subjective economic uncertainty constructed from the CBRT BTS in the spirit of Bachmann et al (2013). For each month *t*, firms

report the expected direction of change (increase, no change, decrease) for a set of forward-looking questions covering production, demand, prices, employment, orders and costs. Let f_{it}^{+} and f_{it}^{-} denote the shares of questions answered "increase" and "decrease," with $f_{it}^{0} = 1 - f_{it}^{+} - f_{it}^{-}$. We summarise within-firm disagreement across dimensions by

$$Uncertainty_{it} = \sqrt{f_{it}^{+} + f_{it}^{-} - (f_{it}^{+} - f_{it}^{-})^{2}}$$

which attains its maximum when responses are evenly split between "increase" and "decrease," and collapses to zero when all answers align. This BTS-based disagreement index is the uncertainty concept used in Table 2 and provides a transparent, model-free summary of how internally consistent a firm's directional expectations are across business margins.

Second, we consider a measure of economic sentiment derived from the BTS question on how the general trend in the firm's industry compares with the previous month, with responses one (optimism), two (neutrality) or three (pessimism). Unlike the two uncertainty constructs, this variable captures the directional tone of firms' assessments rather than the tightness of their beliefs. Information that reduces uncertainty should, under standard models of precautionary behaviour and sticky information, translate into more constructive assessments of near-term conditions, at least temporarily. This link from improved information to better sentiment is consistent with evidence that credible public signals and expert forecasts can anchor beliefs and lift business outlooks in the short run.

Third, complementing this disagreement metric, we also analyse a directly coded BTS question that asks whether predicting future developments has become easier, unchanged or harder compared with the recent past, with responses recorded as one (easier), two (neutral) or three (harder). Conceptually, this variable is a self-assessment of forecasting difficulty. Whereas the Bachmann-style index infers uncertainty from dispersion across many items, the coded question captures managers' meta-perception of how predictable the environment is. A decline in this score after treatment indicates that professional forecasts or policy signals made the state of the world easier to read. The two measures therefore speak to distinct, complementary channels emphasised in the uncertainty literature: disagreement/ambiguity across decision margins and perceived difficulty in forming a reliable view (Bachmann et al (2013); Bloom (2014)).

3.3. Information treatments

The information RCT is designed to influence firms' inflation expectations by delivering targeted information. Each group in the sample is randomly given a publicly available piece of data regarding professional forecasts of inflation, the CBRT's forecasts for 2024 year-end and 2025 year-end, or the CBRT's inflation target.[2] Each group receives one of the following statements on the screen:[3]

[2] Each group consists of approximately 250 observations. Questions about price and wage changes over the past 12 months are asked before the treatment, while all other questions are asked post-treatment.

[3] The selection of firms into treatments is random. See Akarsu et al (2025) for further details and the list of questions.

Treatment 1 — professional forecasts (12-month CPI): "According to the results of the Market Participants Survey for May 2024, the participants' expectation for the Consumer Price Index (CPI) 12 months from now is 33.21%. In other words, professionals expect general prices to increase by 33.21% over the next 12 months."
Treatment 2 — CBRT forecast for 2024: "According to the Central Bank of the Republic of Türkiye's Inflation Report for May 2024, the central bank predicts that annual inflation will be 38% by the end of 2024. In other words, the central bank expects general prices to increase by 38% in 2024."
Treatment 3 — CBRT forecast for 2025: "According to the Central Bank of the Republic of Türkiye's Inflation Report for May 2024, the central bank predicts that annual inflation will be 14% by the end of 2025. In other words, the central bank expects general prices to increase by 14% in 2025."
Treatment 4 — CBRT medium-term inflation target: "Within the framework of the inflation targeting regime, the central bank's inflation target is 5%. In other words, the central bank aims for the general price level to rise by approximately 5% annually in the medium term."

After providing information to each treatment group (with the control group receiving none), respondents were asked several follow-up questions. These included their quantitative expectations for aggregate inflation, producer price inflation, salary growth, unit cost growth, employment changes, price growth of the firm's main product, and both domestic and export sales.

3.4. How inflation uncertainty correlates with firms' real, financial and pricing expectations

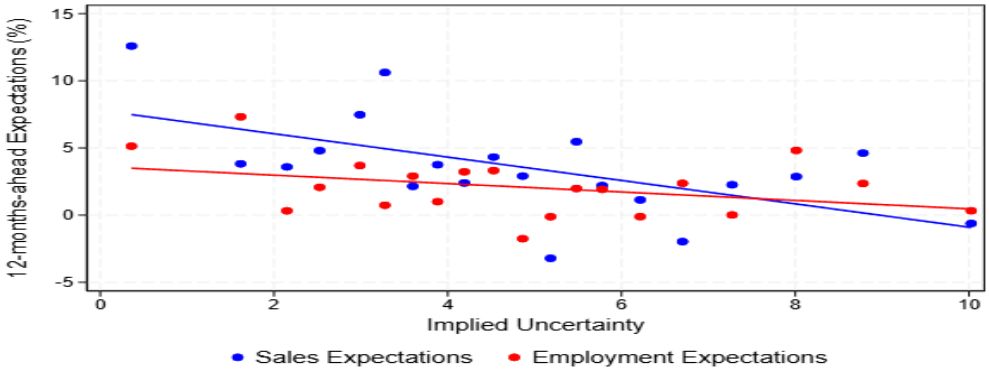
Graphs 3, 4 and 5 document a clear, internally consistent pattern linking firms' implied uncertainty to their forward-looking views about economic activity, financing and pricing. Across all panels we plot covariate-adjusted relationships – partialling out firm size (employment), firm age, exporter status, leverage, and sector- and province-fixed effects – so the slopes isolate how uncertainty co-moves with each outcome holding observables and location/industry heterogeneity constant. This analysis relies on cross-sectional correlations rather than causal inferences. Yet it also indicates the importance of reducing uncertainty in inflation expectations as the latter is strongly correlated with sentiments regarding economic activity and pricing behaviour.

Starting with real activity, Graph 3.A shows that higher uncertainty is associated with weaker 12-month-ahead expectations for sales and employment. This negative association is exactly what models of precautionary behaviour under uncertainty predict: when the outlook becomes noisier, firms trim hiring plans and scale back sales growth projections to preserve flexibility and cash (Bloom (2009); Bachmann and Christian (2013)). The pattern indicates that uncertainty acts like a drag on near-term real activity through the expectations channel, even before any realised shocks materialise. In addition, Graph 3.B turns to business and economic sentiment, coded such that optimism = one, neutral = two and pessimism = three. The upward slope means that higher uncertainty goes hand-in-hand with more pessimistic assessments of both the firm's own prospects and the broader economy. Survey evidence from other settings similarly finds that uncertainty tilts beliefs towards the downside and widens disagreement (Bachmann et al (2013); Coibion et al (2018)). In our data, micro-

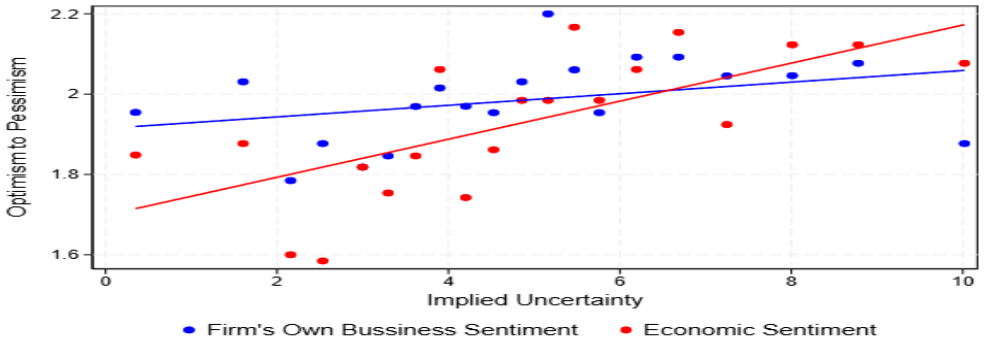
Relationship between firms' implied uncertainty and their expectations

Graph 3

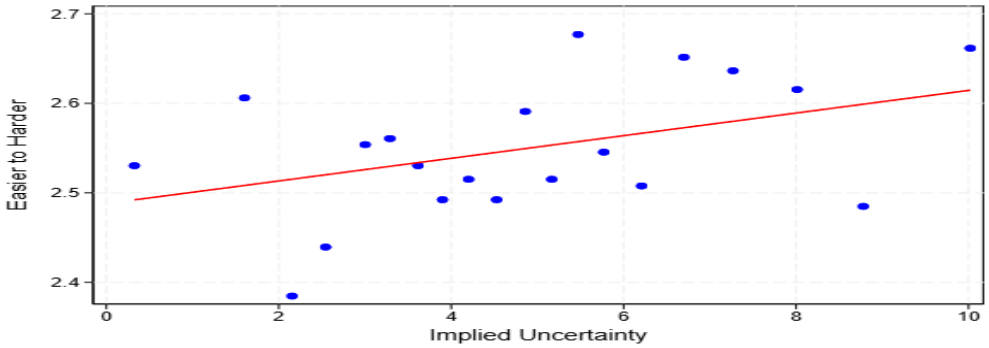
A. Uncertainty and firms' real expectations



B. Uncertainty and pessimism in business and economic sentiment



C. Uncertainty and financial constraint expectations



This figure shows the covariate-adjusted binscatters of firms' implied uncertainty against three sets of expectations. All outcomes and the regressor are residualised for firm size (employment), firm age, exporter status, leverage, and sector and province fixed effects. Graph 3.A relates uncertainty to real expectations (sales and employment). Graph 3.B measures business and economic sentiment, where optimism is coded as one, neutral as two and pessimism as three, so higher values indicate greater pessimism. Graph 3.C examines expected financial constraints, where easier conditions are coded as one, neutral as two and harder conditions as three, such that higher values correspond to tighter financial conditions.

Source: CBRT.

and macro-sentiment move together with uncertainty, suggesting that firms internalise not only their idiosyncratic risks but also a worsening macro backdrop. Finally, Graph 3.C examines expected financial conditions, with the scale coded as easier = one, neutral = two and harder = three. Again we see a positive relationship:

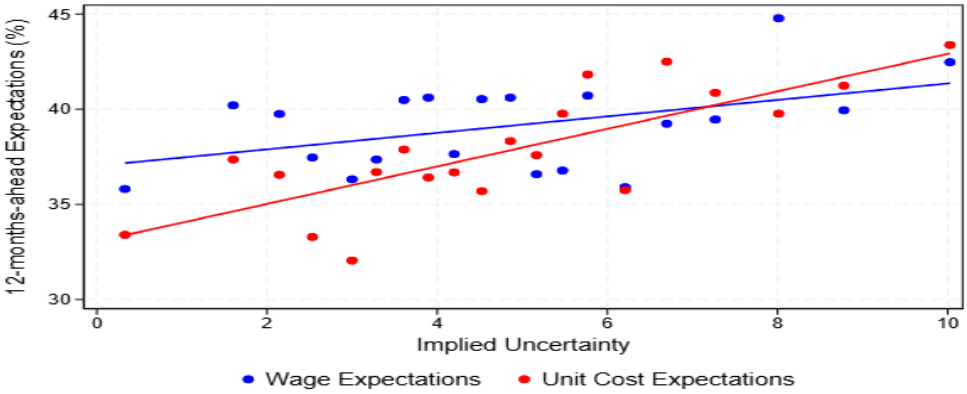
firms that report higher uncertainty also anticipate tighter financing ahead. This is consistent with the idea that uncertainty amplifies financial frictions – by eroding collateral values, widening risk premia or making lenders more selective – thereby restricting external finance just when firms might need it most (Gilchrist et al (2014)). The joint deterioration of sentiment and expected credit conditions helps explain why real plans weaken in Graph 3.A.

Graph 4 links uncertainty to cost pressures and pricing. Graph 4.A shows that wage and unit cost expectations rise with uncertainty. Graph 4.B shows a parallel increase in price expectations. These results point to a supply-side channel: when the environment is more uncertain, firms build in buffer margins – through higher expected wage growth, input costs or markups – to protect against adverse realisations and adjustment costs (Bloom et al (2018)). In high-inflation contexts like Türkiye, this precautionary pricing can become self-reinforcing as suppliers and workers negotiate under risk, pushing up cost expectations that translate into higher planned prices.

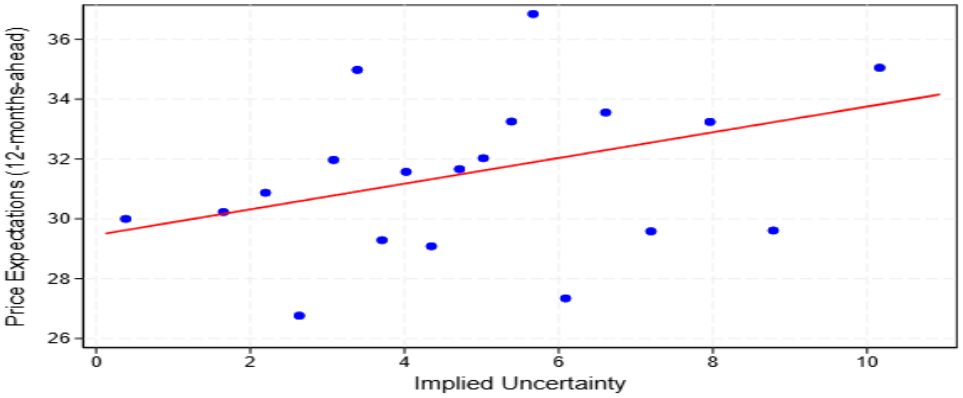
Relationship between firms' implied uncertainty and wage, unit cost and price expectations

Graph 4

A. Uncertainty and wage vs unit cost expectations



B. Uncertainty and price expectations



This figure presents the covariate-adjusted binscatter of firms' implied uncertainty against their cost and price expectations. All outcomes and the regressor are residualised for firm size (employment), firm age, exporter status, leverage, and sector and province fixed effects. Graph 4.A shows the relationship between implied uncertainty and firms' wage and unit cost expectations, and Graph 4.B shows the link between implied uncertainty and firms' price expectations.

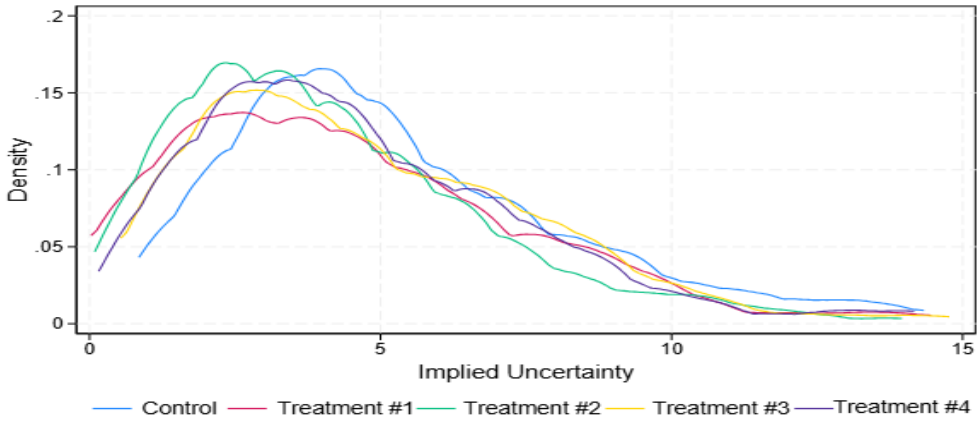
Source: CBRT.

4. Information treatments and the dynamics of uncertainty

4.1. Effect of information treatment on uncertainty

Graph 5 shows that firms assigned to treatment groups exhibit lower distributions of implied inflation uncertainty compared with the control group. This reduction in subjective uncertainty is consistent with a growing literature emphasising the role of targeted information in shaping economic agents' beliefs. For instance, Coibion et al (2022) document that survey-based information treatments can significantly narrow households' forecast dispersions, while Lamla and Vinogradov (2019) show that firms provided with clearer signals revise their expectations in a more anchored way. The intuition is straightforward: when firms receive credible, policy-relevant signals, they face less ambiguity about the macroeconomic environment, leading to tighter subjective distributions over future inflation outcomes. In contrast, untreated firms must rely more heavily on noisy private signals or backward-looking heuristics, which amplify forecast dispersion. Hence, the decline in implied uncertainty across treatment groups reflects an information-anchoring mechanism, whereby credible public signals reduce informational frictions and mitigate the noise inherent in firms' expectation formation.

Distribution of firms' inflation uncertainty by treatment type Graph 5:



This figure presents the densities of uncertainty in inflation expectations for each treatment group.

Source: CBRT.

We estimate how the information treatments affected firms' inflation beliefs and their subjective uncertainty using the same RCT and survey instrument as in our earlier study. Let i index respondents and $k \in \{1,2,3,4\}$ denote the treatment arms, with a contemporaneous control group. Our baseline specification is

$$y_i^{uncertainty} = \beta_0 + \sum_{k=1}^{4} \beta_k \boldsymbol{I}\{i \in Treat\ k\} + \delta_s + \phi_p + X_i'\gamma + \varepsilon_i, \quad (1)$$

where $\boldsymbol{I}\{\cdot\}$ are mutually exclusive treatment indicators, δ_s are sector fixed effects, ϕ_p are province fixed effects and X_i collects pre-treatment covariates that are included solely to improve precision, which are leverage, firm age and exporter

status.[4] Because assignment is randomised, each β_k identifies the average treatment effect on implied uncertainty relative to control, conditional on fixed effects and covariates.

The dependent variable varies by outcome, all measured immediately after the information screens within the same survey session. We first analyse the elicited bounds of beliefs: each respondent reports a minimum and a maximum plausible value for 12-month-ahead inflation, a_i and b_i (percent). We estimate equation (1) separately with $y_i^{min} = a_i$ and $y_i^{max} = b_i$ to trace how treatments shift the lower and upper tails of the subjective predictive distribution. Second, using the triplet (a_i, m_i, b_i) – where m_i is the respondent's most likely (modal) value elicited in the same module – we construct an operational measure of subjective uncertainty. Our primary uncertainty outcome sets $y_i^{uncertainty} = \sigma_i$ in equation (1), where σ_i denotes the implied standard deviation of beliefs (a_i, m_i, b_i) – under our maintained distributional assumption.

The empirical estimates in Table 1 point to a clear and robust decline in perceived uncertainty following exposure to the information treatments. Across both CPI- and PPI-based outcomes, every treatment group reduces the dispersion of firms' inflation beliefs, with effects that are statistically precise in most specifications. Among the arms, the Survey of Professional Forecasters (*SPF) information* (Treatment 1) and the *CBRT current release* (Treatment 2) consistently deliver the largest declines: SPF leads to CPI-based uncertainty, while the CBRT current-release treatment leads to PPI-based uncertainty. By contrast, the CBRT medium-term information (Treatment 3) produces smaller effects, and the CBRT long-term information (Treatment 4) yields moderate but robust reductions.

The treatments also shift the location of beliefs. For both price concepts, respondents revise the minimum and maximum of their expected inflation range downward relative to the control group, with the contraction at the upper bound typically exceeding that at the lower bound (Table 1). Jointly, these movements indicate that the posterior distribution not only shifts left but also tightens, consistent with a reduction in perceived right-tail risks. In short, the information screens do not merely re-centre beliefs; they compress the range within which firms consider future inflation plausible.

Taken together, the evidence in Table 1 aligns with a standard Bayesian mechanism: relative to the control group, information treatments discipline diffuse priors and align expectations more closely with the signal, thereby lowering subjective uncertainty. We therefore conclude that the RCT meaningfully reduces firms' uncertainty about future inflation and shifts beliefs towards lower and less dispersed values, with the strongest effects for the more informative treatments (SPF and the CBRT current release).

[4] Sector and province fixed effects are included to account for systematic heterogeneity in firms' inflation expectations and uncertainty that may arise from structural or regional factors. Sector fixed effects, δ_s, capture differences across industries in exposure to input costs, competitive pressures and demand conditions, which may shape how firms interpret and respond to macroeconomic signals. Province fixed effects, ϕ_p, control for regional variation in economic activity, labour markets and local demand shocks that could otherwise bias estimates of treatment effects.

Table 1: Treatment effect on firms' inflation uncertainty

	CPI			PPI		
	(1)	(2)	(3)	(4)	(5)	(6)
	Minimum	*Maximum*	*Uncertainty*	*Minimum*	*Maximum*	*Uncertainty*
T1 (SPF expectations)	-4.002***	-6.822***	-1.490***	-4.499**	-4.875*	-1.161***
	(1.348)	(2.303)	(0.348)	(1.951)	(2.745)	(0.419)
T2 (CBRT end of year)	-2.707**	-5.635**	-1.416***	-3.363*	-4.890*	-1.302***
	(1.312)	(2.205)	(0.339)	(1.795)	(2.522)	(0.393)
T3 (CBRT end of next year)	-6.529***	-7.452***	-0.815**	-5.920***	-5.984**	-0.731*
	(1.338)	(2.124)	(0.330)	(1.878)	(2.530)	(0.405)
T4 (inflation target)	-3.479**	-4.566**	-0.951***	-2.969	-4.463**	-0.967**
	(1.437)	(2.216)	(0.332)	(1.410)	(2.176)	(0.409)
Sector FE	✓	✓	✓	✓	✓	✓
Province FE	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓
Control mean	58.79	72.97	5.71	55.70	68.79	5.53
R-squared	0.066	0.076	0.086	0.067	0.069	0.078
Observations	1,395	1,395	1,395	1,395	1,395	1,395

This table reports the estimated treatment effects of information interventions on firms' inflation expectations and their associated uncertainty. Columns (1)–(3) present results for CPI inflation, while columns (4)–(6) present results for PPI inflation. The dependent variables are the minimum and maximum bounds of firms' 12-month-ahead inflation forecasts as well as the implied subjective uncertainty, constructed from the elicited distribution of beliefs under a triangular distribution. All regressions are estimated using the Huber robust method to account for outliers and influential observations. Robust standard errors are reported in parentheses. ***p<0.01, **p<0.05, *p<0.1.

4.2. Persistence of information treatment effects in follow-up waves

Table 2 examines how the randomised information treatments propagate beyond the initial survey session by tracking outcomes one to four months after the intervention, denoted $y_{i,t+h}$ for $h \in \{1,2,3,4\}$. Throughout, we estimate average treatment effects with sector and province fixed effects and a small set of pre-treatment firm covariates included solely to improve precision. Because assignment is randomised, the treatment coefficients identify average causal effects relative to a contemporaneous control group at each horizon.

Table 2 documents that the information treatments sharply reduce firms' subjective economic uncertainty, which is defined as the uncertainty about possible economic developments and futures, in the immediate aftermath of the intervention, with effects persisting for one to two months before dissipating. Table 2, Panel A shows that both external benchmarks (professionals' forecast) and CBRT's current year-end and the following year-end forecasts, as well as the inflation target, lead to significant reductions in a within-firm disagreement index. The strongest effects appear within the first two months, after which the coefficients fade towards zero. Panel B confirms the same dynamic using a conceptually distinct measure of uncertainty – firms' direct self-assessment of "forecasting difficulty". The consistency across these two metrics indicates that the intervention genuinely clarified the informational environment, rather than simply altering how managers framed survey answers. In Bayesian terms, the treatments tightened priors, aligning firms' internal narratives across production, demand, costs and prices. This attenuation pattern

aligns closely with rational inattention theories (Mankiw and Reis (2002); Sims (2003)): firms initially update strongly when presented with a salient, low-cost signal, but as new shocks arrive and attention reallocates, belief dispersion returns.

In addition, Panel C highlights that uncertainty reductions are accompanied by temporary improvements in economic sentiment. Treatments based on SPF and the CBRT's year-end forecast generate statistically significant gains in optimism for up to two months, whereas the two-year forecast is weaker and the inflation target has a less consistent impact. This is consistent with precautionary behaviour models, which predict that when ambiguity about the near term shrinks, managers become more comfortable expressing a constructive industry outlook even before hard outcomes adjust (see Bachmann et al (2013); Coibion et al (2022)). Conceptually, the two uncertainty indicators capture distinct channels emphasised in the literature – cross-margin disagreement versus perceived predictability – yet they move together, and sentiment responds accordingly. Taken together, the evidence points to an informational mechanism: credible, near-term signals temporarily anchor beliefs and reduce perceived noise, thereby improving firms' tone and confidence, but the effect decays within a few months unless reinforced.

The evidence underscores that central bank communication can function as a powerful policy instrument: well designed information treatments materially compress firms' uncertainty and lift sentiment, but the effects fade within roughly two months. This temporal profile suggests that one-off signals are insufficient for durable anchoring; rather, guidance should be refreshed at a cadence that matches the observed decay. Coordination across speeches, reports and data releases is crucial to avoid dilution and to reinforce a consistent narrative. Fan charts, reiterating the policy horizon, and explicitly mapping implications for firms' planning cycles can further reduce interpretive ambiguity. Finally, the central bank should monitor simple, high-frequency key performance indicators, such as survey disagreement indices or self-reported forecasting difficulty, to track when uncertainty begins to increase. In short, credible and repeated communication buys valuable space for monetary policy to work through the expectations channel by sustaining lower uncertainty and more constructive sentiment.

Table 2: Persistence of information treatment effects: uncertainty and sentiment in follow-up waves

	(1) $y_{i,t+1}$	(2) $y_{i,t+2}$	(3) $y_{i,t+3}$	(4) $y_{i,t+4}$
	Panel A: Within-firm subjective uncertainty			
T1 (professionals' forecast)	-0.278***	-0.266***	-0.094**	-0.102**
	(0.078)	(0.041)	(0.045)	(0.046)
T2 (CBRT 1-y ahead forecast)	-0.207**	-0.219***	-0.038	-0.087*
	(0.087)	(0.041)	(0.044)	(0.045)
T3 (CBRT 2-y ahead forecast)	-0.278***	-0.153***	-0.011	-0.047
	(0.066)	(0.041)	(0.043)	(0.045)
T4 (inflation target)	-0.300***	-0.171***	-0.189***	0.030
	(0.065)	(0.042)	(0.043)	(0.045)
R-squared	0.227	0.084	0.080	0.056
	Panel B: Firms' self-assessment of forecasting difficulty			
T1 (professionals' forecast)	-0.037***	-0.034***	0.001	0.002
	(0.004)	(0.005)	(0.005)	(0.005)
T2 (CBRT 1-y ahead forecast)	-0.027***	-0.025***	0.002	0.000
	(0.005)	(0.005)	(0.005)	(0.006)
T3 (CBRT 2-y ahead forecast)	-0.024***	-0.025***	-0.003	-0.002
	(0.004)	(0.005)	(0.005)	(0.005)
T4 (inflation target)	-0.014***	-0.012**	0.001	0.002
	(0.004)	(0.005)	(0.005)	(0.005)
R-squared	0.101	0.086	0.042	0.054
	Panel C: Future economic sentiment/outlook			
T1 (professionals' forecast)	0.127***	0.067***	0.086***	0.054
	(0.046)	(0.025)	(0.031)	(0.038)
T2 (CBRT 1-y ahead forecast)	0.112***	0.071***	0.082***	0.055
	(0.043)	(0.024)	(0.030)	(0.040)
T3 (CBRT 2-y ahead forecast)	0.054*	0.017	0.009	0.009
	(0.029)	(0.023)	(0.031)	(0.038)
T4 (inflation target)	0.059**	0.013	0.048	0.072*
	(0.027)	(0.022)	(0.031)	(0.037)
R-squared	0.117	0.051	0.072	0.048
Sector FE	✓	✓	✓	✓
Province FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Observations	1,395	1,395	1,395	1,395

Each column reports treatment effects estimated one to four months after the information intervention, denoted $y_{i,t+h}$ for $h = 1,2,3,4$. Panel A uses a firm-level subjective uncertainty index constructed from BTS responses in the spirit of Bachmann et al (2013), which captures disagreement across forward-looking questions on production, demand, prices, employment, orders and costs. Panel B relies on the directly coded BTS question on forecasting difficulty, where responses are scored as one = easier, two = unchanged and three = harder, with higher values indicating greater perceived uncertainty. Panel C measures firms' economic sentiment from the BTS question on the general trend in their industry relative to the previous month, coded as one = optimism, two = neutrality and three = pessimism. All regressions are estimated using the Huber robust method to account for outliers and influential observations. Robust standard errors are reported in parentheses. ***p<0.01, **p<0.05, *p<0.1.

5. Conclusion

This paper investigates how randomised information treatments shape firms' uncertainty in inflation expectations and economic sentiment in Türkiye. Leveraging a randomised controlled trial conducted immediately after the May 2024 BTS, we show that concise, policy-relevant information significantly compresses belief dispersion and temporarily anchors expectations. The treatments also reduce a within-firm multi-item disagreement index and lead to improvement in firms' own self-assessed forecasting difficulty. The effects last up to two months.

Beyond belief updating, our evidence highlights how uncertainty propagates into firms' sentiments regarding economic activity and financial conditions. Higher perceived uncertainty is associated with weaker sales and employment plans, more pessimistic industry assessments, tighter anticipated financial conditions, and higher cost and price expectations.

Taken together, our findings underscore the importance of credible and repeated central bank communication as a policy tool. Public signals can meaningfully reduce uncertainty and improve sentiment, but the effects decay quickly unless reinforced. In practice, this implies that central banks can work through expectations channels by delivering clear, state-contingent guidance in a cadence that matches the observed attenuation of information effects. More broadly, our results contribute to the literature on expectation formation and uncertainty by providing causal evidence from firms in an emerging market, demonstrating that communication policies matter not only for inflation forecasts but also for the broader economic environment in which firms operate.

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Risk and uncertainty in a post-pandemic world: implications for the economy, financial markets and monetary policy[1]

Juan Londono, Sai Ma and Ilknur Zer (Federal Reserve Board[2])

"A common observation is the need for clear communications as complex events unfold. A critical question is how to foster a broader understanding of the uncertainty that the economy generally faces."

Jerome Powell, 15 May 2025[3]

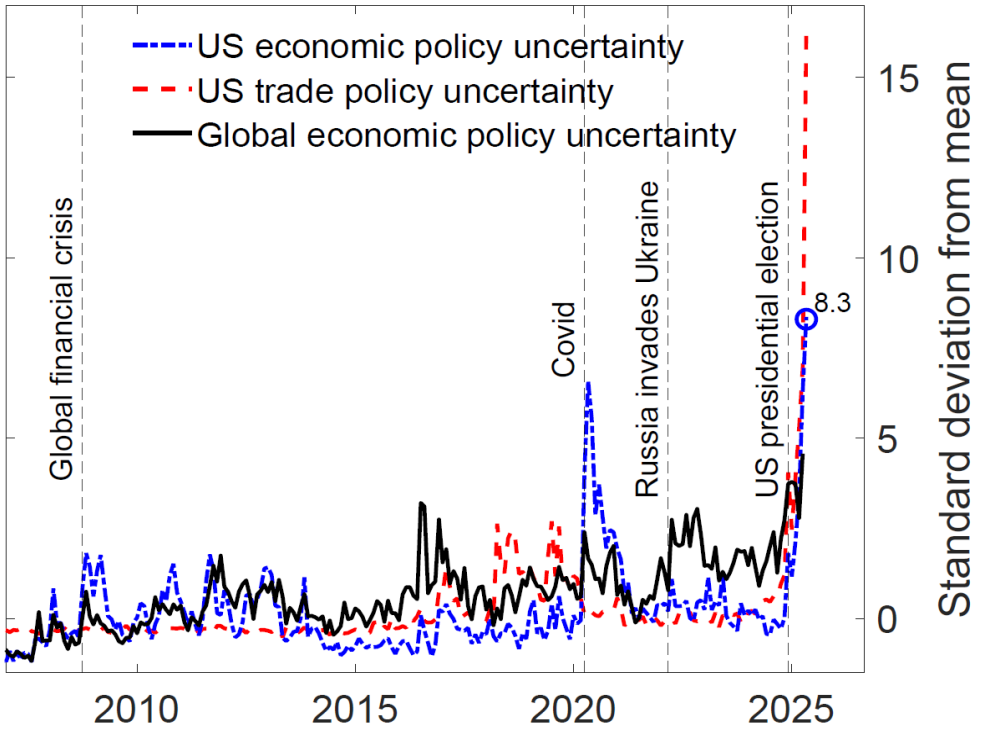
Over the past five years, the Covid-19 pandemic, supply chain disruptions, concerns about trade policy and their implications for the global trading network, military conflicts and broader geopolitical tensions have sharply heightened risk and uncertainty. US and global economic policy uncertainty reached unprecedented levels in April 2025, mostly driven by uncertainty about trade policies (Graph 1). The uncertainty is pervasive – the large shocks that have hit the global economy in recent years have moved uncertainty about the state and structure of the economy, and the formation of the public's expectations about the economic outlook and monetary policy, to the forefront of the global stage. Moreover, heightened uncertainty due to unprecedented shocks is occurring in a landscape that is also undergoing many structural changes, such as those related to technology, demographics and weather, and against a backdrop of greater fiscal imbalances and elevated debt levels, all of which add to the uncertainty. Much of the risk and uncertainty is due to global factors that exacerbate international spillovers across highly interconnected economies and financial markets.

[1] This paper was adapted from J Londono, S Ma and I Zer, "The Fourth SNB-FRB-BIS High-Level Conference on Global risk, uncertainty and volatility: risk and uncertainty in a post-pandemic world; implications for the economy, financial markets and monetary policy", *FEDS Notes*, July 2025.

[2] We would like to thank the rest of the global risk, uncertainty and volatility conference organising committee: Nina Hugelshofer, Kerstin Kehrle, Rina Rosenblatt-Wisch and Thomas Moser from the Swiss National Bank and Gabor Pinter, Ilhyock Shim and Vladyslav Sushko from the Bank for International Settlements. We would also like to thank Maria Jovanovic for her outstanding assistance with this note and Shaghil Ahmed and Beth-Anne Wilson for their excellent comments. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the Board of Governors.

[3] J Powell, "Opening remarks" at the Second Thomas Laubach Research Conference, Washington DC, 15 May 2025: https://www.federalreserve.gov/newsevents/speech/powell20250515a.htm.

Major economic policy uncertainties Graph 1



Sources: www.policyuncertainty.com; Baker, Bloom, and Davis (2016); Caldara et al. (2020)

This complex environment poses major challenges for households, businesses, market participants and policymakers alike. To capture the extent of uncertainty over the last half decade, the range of quantitative metrics of uncertainty has expanded along all dimensions – statistical, financial, survey-based and text-based – as has our understanding of how these measures scope into key economic conditions, such as investment, employment, output, inflation and lending. Models have also been modified to better capture the transmission channels of uncertainty, such as financial, trade and supply chain channels. Moreover, policy authorities have reassessed monetary policy strategies in the face of risks and uncertainty, including more focus and emphasis on how central banks should communicate uncertainty.

Since 2018, the Federal Reserve System has been fostering the study of macroeconomic risk and uncertainty, and their effects on the economy, through a series of conferences on global risk, uncertainty and volatility. With the recent events and challenges in mind, the fourth High-Level Conference on "Global risk, uncertainty and volatility", which took place in Switzerland on 13 and 14 May 2025, brought together academics and policymakers to discuss the new sources of risk and uncertainty, their impact on economic behaviour and financial markets, and their implications for monetary policy strategies. The conference was jointly organised by the Swiss National Bank (SNB), the Division of International Finance at the Federal Reserve Board (FRB) and the Bank for International Settlements (BIS).[4]

[4] More information about the conference, including the programme and the papers presented, can be found at the SNB's website: https://www.snb.ch/en/services-events/events/scientific-conferences/snb_frb_bis_high_level_conference_on_gruv/sem_2025_05_13.

This year's conference provided key takeaways related to how unprecedented and persistent uncertainty affects monetary policy transmission, policy tools and communications, inflation and inflation expectations, as well as labour markets. First, the discussion underscored that uncertainty plays a crucial role in economic decision-making and outcomes, from reshaping workforce composition and global value chains to influencing household beliefs and financial decisions, banking sector behaviour and the effectiveness of monetary policy. Another key theme was the growing importance of effective communication by policymakers in times of high uncertainty, when traditional tools, such as baseline forecasts or forward guidance, may be less informative. Finally, the conference also shed light on understanding the fundamentals of geoeconomics and its transmission channels, including how it affects international spillovers.

The conference opened with remarks by Martin Schlegel, Chairman of the Governing Board of the SNB, who discussed the economic transmission channels of uncertainty and its international spillovers, with a focus on the potential effects on the Swiss economy. The conference also featured a policy keynote speech by Jose Luis Escriva, Governor of the Bank of Spain, who, speaking on monetary policy in times of extreme uncertainty, emphasised that traditional analysis may become less relevant, and central banks must adopt more creative approaches. In such extreme environments of uncertainty, monetary policy frameworks should be more data-driven, highly agile and robust to remain effective across a range of shocks. Accordingly, forward guidance should be used cautiously, as it can limit the flexibility that is essential in uncertain conditions.[5]

This year's conference featured two panel discussions by senior policymakers. The first panel, chaired by Andréa Maechler, Deputy General Manager of the BIS, discussed the financial and economic implications of new and prominent sources of uncertainty. The second panel, chaired by Beth Anne Wilson, Director of the International Finance Division at the FRB, discussed how current sources of uncertainty affect the appropriate strategy for monetary policy and for policy communication.[6] In these panel sessions, participants emphasised that today's environment was marked by fatter tails, compressed decision windows and greater communication challenges.

Several themes emerged. First, fatter tails and heightened uncertainty make economic outcomes harder to predict or quantify, and, when combined with delays in data availability, increase the risk of missing inflation targets, which, in turn, can undermine central bank credibility. Second, limited policy tools combined with lack of clarity about shock characteristics, for example, whether shocks are supply or demand driven, or temporary or permanent, complicate policy decision-making and messaging. Third, due to the current historically high uncertainty, monetary policy communication has become more challenging, especially in the context of elevated debt levels and volatile financial markets. In line with Governor Escriva's remarks, panellists highlighted that one key communications challenge relates to the use of forward guidance, traditionally a key tool for central bankers to signal their intentions,

[5] J L Escrivá, "Monetary policymaking in a context of extreme uncertainty", Fourth High-Level Conference on "Global risk, uncertainty, and volatility", 13 May 2025.

[6] The panellists were: Ayman Alsayari, Governor of the Saudi Central Bank; Fatih Karahan, Governor of the Central Bank of the Republic of Türkiye; Dave Ramsden, Deputy Governor of the Bank of England; Seiichi Shimizu, Assistant Governor of the Bank of Japan; Petra Tschudin, Member of the Governing Board of the Swiss National Bank; and Amir Yaron, Governor of the Bank of Israel.

but which becomes much harder to implement effectively in episodes of heightened uncertainty. Finally, panellists highlighted other factors complicating the policy landscape, including growing trade fragmentation, supply chain disruptions, greater policy divergence, the rise of non-bank financial institutions and rapid digitalisation.

The conference also featured a policy keynote speech on inflation by Charles Evans, former President and CEO of the Federal Reserve Bank of Chicago. Dr Evans discussed how money and relative price illusion shape public expectations, noting that a rising price level is often perceived as a failure of monetary policy. He reflected on the tension this creates for central banks, which may face growing pressure to respond to specific price changes, such as for petrol or food, despite these being outside their traditional inflation mandate.

Turning to the academic papers presented at the conference, some of these also discussed issues related to inflation and inflation uncertainty. Dimitris Georgarakos, from the European Central Bank (ECB), presented his work on the effects of inflation uncertainty on household beliefs. Dimitris and his co-authors show that higher inflation uncertainty leads households to reallocate their financial portfolios away from retirement funds and stocks towards more liquid assets like current and savings accounts. They also show that inflation uncertainty reduces durable consumption and increases precautionary saving and job searching.

Min Wei, from the Federal Reserve Board, presented her work exploring how dispersion in household inflation expectations weakens the effectiveness of both conventional monetary policy and forward guidance. Min and her co-authors show that, when inflation disagreement is high, the impact of policy rate shocks on consumption is significantly attenuated. These results highlight the importance of considering household heterogeneity in inflation expectations when analysing monetary policy transmission and effectiveness.

The paper by Fiorella De Fiore of the BIS focused on the theme of effective communication by policymakers in times of high uncertainty, which was also prominent in Governor Escriva's keynote address and in the panel discussions. Fiorella showed that, while Federal Open Market Committee (FOMC) messages are generally well reflected in the media, it is the tone of media sentiment – rather than the original FOMC communication itself – that shapes household inflation expectations, particularly in times of high inflation. These findings point to the importance of effective central bank communication through the media to influence public perceptions and expectations.

Three papers presented at the conference focused broadly on the effects of uncertainty on labour markets. The first of these papers by Andrea Caggese, from Universitat Pompeu Fabra and Barcelona School of Economics, showed that uncertainty shocks have heterogenous effects on firms' employment decisions and workforce composition. The authors construct a novel firm-level uncertainty index based on firms' exposure to various commodities and to their price fluctuations. They document that increased uncertainty reduces the likelihood of firms firing younger, shorter-tenured and more skilled workers, as firms value the flexibility these workers offer.

The second paper related to labour markets, by Marius Faber of the SNB, focused on how uncertainty affects global value chains, especially by increasing incentives to reshore or near-shore, which ultimately affects labour market outcomes across countries. Marius showed that rising uncertainty leads to significant reshoring of

production and thus has likely contributed to the slowdown in globalisation observed since the Great Financial Crisis.

The third paper on labour market implications was by Hamid Firooz of the Federal Reserve Bank of San Francisco. Firooz and his co-authors explore the role of the complementarity of uncertainty and automation for reshoring and thus its transmission to labour markets. They show that trade uncertainty creates incentives for firms to reshore production, potentially reducing reliance on foreign suppliers. However, this reshoring does not necessarily translate into increased domestic employment or higher wages, particularly when firms have access to automation technologies. While increased automation raises labour productivity, it can also displace jobs, especially for unskilled workers. These effects are amplified in economies that are more open to trade, have more automated production or face more persistent trade uncertainty.

The final main theme of this year's conference was uncertainty related to geoeconomics. Professor Matteo Maggiori, from Stanford University, gave an academic keynote talk on geoeconomic risks. He presented a framework to understand how hegemonic countries use financial and trade linkages as tools of economic coercion and highlighted how certain key sectors, especially financial sectors, can amplify power imbalances among countries and trigger global fragmentation through policy responses.

The paper by Leslie Sheng Shen, from the Federal Reserve Bank of Boston, focused on the link between geopolitical risk and global banking. She and her co-author show that internationally active banks play a key role in the transmission of geopolitical risk to the domestic credit markets. An unintended consequence of the inability to properly derisk from countries affected directly by geopolitical risk is that banks are forced to reduce lending and tighten domestic standards to domestic firms where the banks are headquartered to comply with capital regulation that requires them to hold a certain amount of capital against risk-weighted assets.

South African Reserve Bank: resilient policy in an uncertain world

By Christopher Loewald and Manisha Morar[1]
October 2025

In recent years, central banks around the world have had to steer policy through an environment of heightened uncertainty. Shocks have become more frequent and varied – ranging from energy and food price volatility to geopolitical tensions, climate events, supply chain bottlenecks and sudden shifts in global financial conditions – all of which are difficult to anticipate or quantify. In South Africa, these global forces intersect with domestic challenges such as weak infrastructure and electricity supply disruptions. In this context, the South African Reserve Bank (SARB) has sought to maintain credibility and transparency while ensuring that its monetary policy decisions remain robust to a wide range of possible outcomes.

Types of uncertainty

Uncertainty takes many forms. Statistical or parameter uncertainty arises from measurement error, model estimation and forecast variance. To capture this, the SARB publishes fan charts and regularly highlights revisions to past data, reminding the public that data is never perfect (and that the future cannot be accurately predicted). Forecast error analysis is an integral part of our process – enabling us to assess the accuracy of projections and identify ways to strengthen the forecasting framework for greater efficiency and resilience.[2]

Given that the Quarterly Projection Model (QPM) is structured around output, inflation, interest rate and exchange rate gaps, uncertainty can arise at two levels: first in measuring "fundamental drivers", and second in any inference that relies on them.[3]

[1] Christopher Loewald: Chief Economist and Head of Economic Research Department, South African Reserve Bank. Manisha Morar: Lead Economist, Economic Research Department, South African Reserve Bank.

[2] For instance, in the April 2025 *Monetary Policy Review*, Box 7 indicates that inflation was lower than forecast in 2024 driven by a stronger rand, lower oil prices, subdued unit labour costs and more economic slack. Beyond assumptions and starting points, monetary policy itself can also influence forecast errors, particularly when policy adjustments are not yet fully reflected in near-term projections. If, for example, interest rates are set above the level suggested by the QPM, inflation drivers may perform more favourably than expected. In this sense, the lower-than-forecast inflation outcome can partly be seen as a result of effective monetary policy.

[3] For details on the QPM, see E Pirozhkova, J Rakgalakane, L Soobyah and R Steinbach, "Enhancing the quarterly projection model", *South African Reserve Bank Working Paper Series*, no 5, June 2023. Relatedly, C Vermeulen, "The inherent uncertainties in output gap estimation: a South African perspective", *South African Reserve Bank Working Paper Series*, no 8, August 2023, underscores how real time estimates of potential output and the output gap are vulnerable to definitional uncertainty, choice of methodology and data revision. Consequently, central banks should consider a range of plausible gap estimates rather than depend on point estimates.

Recognising this highlights where judgment can be overlaid, either to compensate for model limitations or to incorporate non-model information.

For scenario uncertainty, the SARB develops alternative scenarios which show what the policy rate path would look like if certain risks materialised, under each scenario. This helps explore a range of possible trajectories when underlying conditions differ from the baseline. Results are typically expressed as deviations from the baseline forecast – for example, a higher oil price scenario might show inflation peaking 1 percentage point higher and the repo rate path 50 basis points steeper. The SARB has a long history of considering alternative scenarios. However, their (selective) publication gained prominence after the independent Bernanke Review of the Bank of England's forecasting and policy framework in April 2024, which recommended using scenarios to enhance transparency.[4]

Finally, there are "unknown unknowns" – those shocks that cannot be anticipated. Here the emphasis shifts to robustness and flexibility. The Monetary Policy Committee (MPC) relies on shorter decision horizons, data dependence and the ability to adjust policy quickly as new information becomes available.

Uncertainty in models

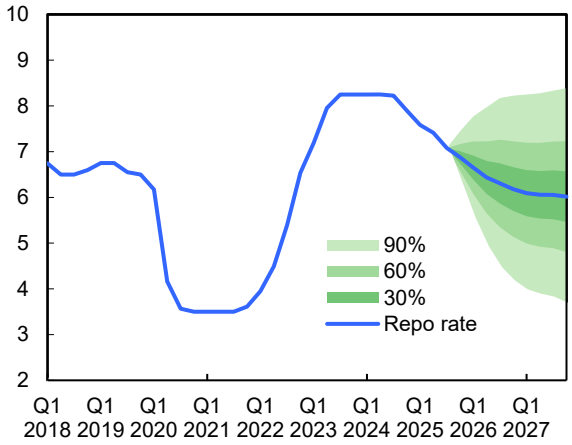
Uncertainty is incorporated into the SARB's modelling framework in several ways. At each monetary policy meeting, held six times a year, a statement on the decision is published alongside documents outlining key assumptions, forecast results and a repo rate fan chart. The fan chart shows both the historical and projected paths of the policy rate and is constructed by running the model repeatedly with shocks drawn from historical forecast errors. This process generates symmetric confidence bands at the 30, 60 and 90% levels, as shown in Graph 1. Although the symmetry means the bands do not capture any judgment about upside or downside risks, they offer a clear probabilistic representation of outcomes around the baseline projection, making the inherent forecast uncertainty explicit.

[4] In September 2024, the MPC referenced scenarios related to an inflation under- and overshoot. In the November 2024 statement, the prospect of higher administered price inflation was explored, while another scenario envisaged a more difficult external environment, with a weaker rand and higher oil prices. In January 2025, the MPC reviewed a trade war scenario, and one of accelerated domestic reforms. In March 2025, a slowdown in the United States, alongside a weaker dollar and higher commodity prices, was an external scenario. The MPC also considered scenarios related to the loss of South Africa's African Growth and Opportunity Act (AGOA) status, and if that were to be compounded by tariffs. The most severe scenario added a sentiment shock. In May 2025, the MPC published a medium and high tariff scenario impact, as well as a scenario with a 3% inflation objective – laying the groundwork for the replacement of a 4.5% QPM baseline with a 3% anchor in July 2025. In September 2025, scenarios were considered in which inflation expectations adjusted more slowly than in the baseline. The scenarios treated expectations as more backward looking, with less attention paid to the SARB's communication.

Repurchase rate forecast

In per cent

Graph 1



* As of September 2025.

Source: SARB.

The construction of scenarios, in turn, takes into account a range of factors: exogenous shocks (such as alternative oil or food price projections), domestic risks (including shifts in government debt levels or electricity supply disruptions), global developments (for example, a weaker US dollar) and policy sensitivities (such as different repo rate paths under alternative assumptions).

Scenarios are especially powerful: they illustrate how policy might respond if risks materialise, reinforcing that policymakers are prepared and proactive rather than reactive. They also help explain why the MPC may sound more cautious or hawkish than the baseline forecast alone would suggest. At the same time, scenarios strengthen credibility by demonstrating that the SARB systematically considers uncertainty, not just the central path. For market participants, this reduces the likelihood of being surprised by policy moves. Care is taken, however, to ensure that scenarios do not mislead or become unintended focal points for expectations.

Staff members also update policymakers on market-based measures that embed investor expectations and risk premia. These include volatility indices such as the Cboe Volatility Index (VIX) and Merrill Lynch Option Volatility Estimate (MOVE), shifts in money market pricing of central bank interest rate decisions, and indices measuring trade and economic policy uncertainty.

Implications for the policy reaction function and communication

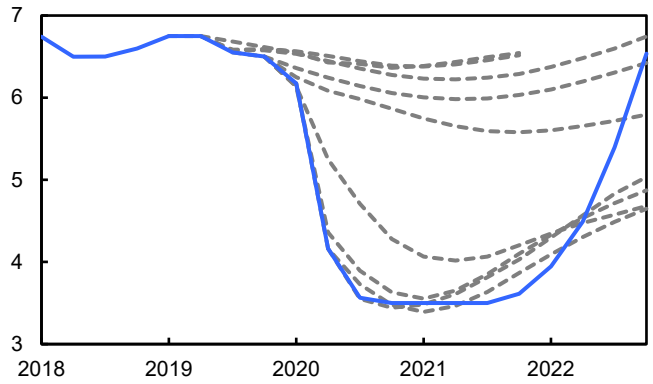
Uncertainty makes the MPC less likely to follow a mechanical Taylor-type rule approach. If uncertainty is high, policymakers may adopt a cautious stance – adjusting rates in smaller increments or waiting for more data before moving decisively. Statistics are often revised (for example, GDP, employment and trade), and real-time readings may be misleading. The MPC explicitly discusses this. The QPM baseline is robustly debated and a risk management approach is adopted – focusing not only on the baseline forecast but also on the potential costs of being wrong.

The MPC distinguishes between temporary shocks – such as one-off spikes in food or oil prices, which are often best "looked through", and more persistent or unusually large shocks that generate second-round effects on wages, inflation expectations and core inflation.

Covid-19 highlighted the SARB's capacity to recalibrate monetary policy in response to unprecedented uncertainty. Faced with a sharp contraction in output and heightened financial market stress, the MPC responded forcefully, reducing the repo rate by 300 basis points in the first half of 2020. As illustrated in Graph 2, the solid blue line (that is, the actual policy rate) diverged from the QPM's implied paths (dashed lines) for meetings between July 2019 and July 2020, reflecting the MPC's judgment-based response as opposed to a mechanical application of model guidance. Unscheduled MPC meetings were held, and extraordinary liquidity measures were introduced to stabilise markets. At the same time, communication was stepped up through press briefings and explanatory statements.

QPM-implied rate path vs policy rate

In per cent — Graph 2



* Dotted lines indicate implied policy rate path from the QPM's Taylor rule for various MPC meetings in 2019 and 2020.

Source: SARB.

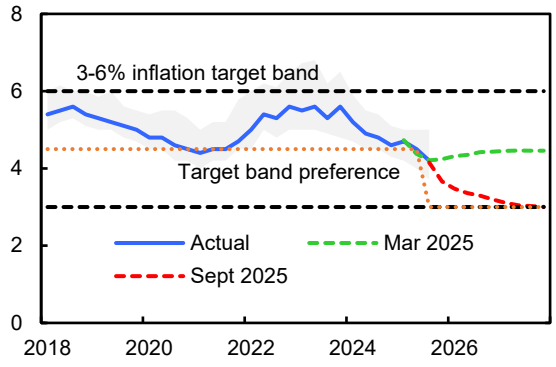
Relatedly, forward guidance is typically qualitative. Hard numerical commitments – for example, pledging that "rates will remain at X until Y" – risk undermining credibility if conditions change abruptly. Instead, predictability is fostered through a systematic framework: an explicit inflation targeting regime, transparent forecasts, fan charts and regular communication of the balance of risks. At the same time, the MPC retains discretion to respond flexibly to shocks not well captured by models, such as load-shedding, geopolitical events or rand volatility.

If we consider the recent past, the SARB began explicitly emphasising a 4.5% midpoint target – within the official 3 to 6% inflation band – in 2017. Through consistent communication and greater transparency around the forecasting model, inflation expectations were gradually anchored lower. Importantly, disinflation was not driven by recessionary dynamics – that is, it did not result from aggressive interest rate hikes or a sharp contraction in demand. While growth was admittedly weak over this period, the primary causes lay in structural constraints, indicating that the disinflation process itself had only a limited impact on growth. Importantly, the anchoring of expectations has helped reduce domestic uncertainty by limiting the risk of second-round effects. As of July 2025, the MPC's preference is to target inflation at the lower bound of the range. Under this baseline, inflation expectations for analysts, businesses and trade unions are forecast to moderate further, as shown in Graph 3, as credibility in the SARB's commitment to price stability strengthens. By aligning more closely with global norms, the revised inflation objective will help to lower domestic borrowing costs, lower the volatility of inflation and create a more stable environment for investment and long-run growth.[5]

Two-year-ahead inflation expectations: all groups

In per cent

Graph 3



* Shaded region indicates interquartile range of survey respondents; dotted lines indicate forecasts.

Sources: Bureau for Economic Research; SARB.

[5] See C Loewald, R Steinbach and J Rakgalakane, "Less risk and more reward: revising South Africa's inflation target", *South African Reserve Bank Working Paper Series*, no 5, May 2025. Relatedly, Box 1 in the October 2025 *Monetary Policy Review* notes that, when decomposed, inflation expectations have, since 2017, been driven predominantly by a forward-looking component – proxied by the inflation target – rather than by a backward-looking component, namely headline inflation. This indicates credible policy anchoring and suggests that a shift to a lower target could occur without destabilising expectations.

Other recent research reinforces the importance of central bank communication as a policy instrument.[6] Specifically, credible communication around inflation targeting and central bank independence can lower perceived risk, reduce borrowing costs and improve the transmission of policy. These findings underline that in an emerging market context, effective communication does more than explain decisions – it actively shapes financial conditions and enhances resilience under uncertainty.

Conclusion

The South African experience highlights how a central bank can embed uncertainty considerations into each stage of decision-making and communication. By combining formal modelling, scenario analysis, judgmental overlays and qualitative forward guidance, the SARB strives to balance credibility with flexibility.

The broader lesson is that while uncertainty can never be eliminated, central banks can demonstrate resilience in the way policy responds to it. Through clear and consistent communication, the SARB works to keep expectations anchored and build trust in its policy approach.

[6] See for instance, E Pirozhkova, G Ricco and N Viegi, "Trouble every day: monetary policy in an open emerging economy", University of Pretoria, *Department of Economics Working Paper Series*, no 42, September 2024.