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The Philippine Review of Economics

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The BSP's Forecasting and Policy Analysis System

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The Bangko Sentral ng Pilipinas (BSP) subscribes to the Forecasting and Policy Analysis System (FPAS) as the framework for macroeconomic forecasting and analysis in support of monetary policy formulation. FPAS is a standard framework, adopted by many inflation-targeting central banks, that organizes the generation, consolidation, and analysis of economic information relavant to monetary policy formulation. This paper aims to describe how macroeconomic forecasts and policy simulations are generated to support monetary policy analysis and formulation at the BSP. To this end, this article summarizes the main features of the process involved in generating the baseline forecasts, alternative scenarios, and policy simulations. We highlight the complementary roles played by the BSP's suite of models and the expert judgement from the sector specialists as well as the importance of forecast communication in the transmission of monetary policy. Finally, we present a systematic evaluation of the forecasting performance of the BSP from 2010 to 2020 together with some of the lessons in forecasting during the COVID-19 pandemic and the recent efforts to improve the BSP's FPAS.

JEL classification: C5, E5
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1. Introduction

Since the adoption of inflation targeting (IT) as the framework for monetary policy in 2002, forecasting inflation with reasonable precision had become a key priority for the Bangko Sentral ng Pilipinas (BSP) due to the forward-looking nature of monetary policy formulation. IT central banks, including the BSP, formulate policies generally based on a reasonable picture of the macroeconomy and risks surrounding it over the policy horizon.

The use of models establishes a structure for policy analysis by providing a theoretical framework to understand and summarize key economic relationships. Models are also natural storytelling devices that facilitate external communications.

The BSP uses a variety of methodologies ranging from purely time series techniques to semi-structural and theoretical models. These are used for generating forecasts of inflation and other key macroeconomic variables to guide the economic surveillance activities of the BSP in aid of monetary policy decision making as well as policy evaluation.

BSP modelling efforts subscribe to a "thick" modelling philosophy by maintaining a suite of models for forecasting and policy simulation. According to Pagan [2003], it is desirable to maintain a diverse set of models since no single model can address all policy issues. In addition, the selection of appropriate model requires a careful balance of the trade-off between theoretical and empirical coherence. The "thick" modelling approach recognizes the natural limitations of models to (i) forecast accurately the exact path of the variables over the forecast horizon; and (ii) adequately address or cover all policy issues in the economy. In other words, this modelling approach addresses the inherent trade-off between model tractability and model size and depth that allow for richer structural features. In recognizing these limitations, the suite-of-models approach offers flexibility to address different policy issues and forecasting requirements of monetary policy analysis.

The use of macroeconometric models for forecasting and policy analysis is common in IT central banks which combine fully-structural and semi-structural types of models to generate their baseline projections. Thus, the BSP's pluralistic approach to modelling is consistent with the practice among central banks of maintaining various models (i.e., economy-wide or specific to some sectors such as oil and housing market, among others) for forecasting as well as for scenario analysis and risk assessment (Table 1). The pluralistic approach to macroeconomic modelling is similarly employed by the International Monetary Fund (IMF) to address a broad range of policy issues globally and in individual countries [Isard 2000]. Such policy questions include the spillover effects of policy changes, implications of rise in global oil prices, and sustainability of a country's pension system, among others. The utilization of nowcasting models along with the judgment of sector specialists is also a common practice among central banks as part of their forecasting process.

TABLE 1. Economic models for forecasting and policy analysis at various central banks

Name of central bank	Economic models for forecasting and policy analysis
Bank of Canada	• Terms-of-Trade Economic Model (TOTEM), a large-scale multi-sector dynamic stochastic general equilibrium (DSGE) model • International Model for Projecting Activity (IMPACT), a global semi-structural model • Global Projection Model (BOC-GPM) • Large Empirical and Semi-structural model (LENS) • Model for the US Economy (MUSE), a macroeconometric model
Bank of Thailand	• Bank of Thailand Macroeconometric Model (BOTMM) • Small semi-structural model • DSGE model • Other economic models (corporate sector model, household model, vector autoregressive models or VARs)
Czech National Bank	• Core quarterly projection model • Monitoring and near-term forecasting models (e.g., ARIMAX) • Signal extraction models • Dynamic optimizing multi-sector model with stock-flow relationships • Satellite models
European Central Bank	• New Area-Wide Model (NAWM), a DSGE model • New Multi-Country Model (ECB-MC), a multi-country semi-structural model • Satellite models (e.g., Bayesian VAR)
Monetary Authority of Singapore	• Monetary Model of Singapore (MMS), a macro computable general equilibrium model • Satellite Model of Singapore (SMS), a macroeconometric model
Reserve Bank of Australia	• Full-system economic models (VAR; Factor Augmented VAR; Stuctural VAR; Vector Error Correction Model or VECM; Macroeconomic Relationships for Targeting Inflation or MARTIN; DSGE) • Single-equation economic models (exports ECM; Okun's law model, Australian dollar ECM; Phillips curve; Inflation mark-up model; Asset pricing model)
Reserve Bank of New Zealand	• New Zealand Structural Inflation Model (NZSIM), a combination of core DSGE model and auxillary equations • Statistical models (Factor models, Bi-variate indicator models, VAR, and Bayesian VAR)
South African Reserve Bank	• Core econometric model, a structural ECM • Quarterly projection model • DSGE model

Note: The above list is not exhaustive and is subject to change.
Source: Official central bank websites.

It should be emphasized that the BSP does not employ models as black boxes. Significant inputs and judgment from sector experts and management are incorporated in the forecasting and modelling exercises to form a coherent narrative. At the same, there is recognition of the inherent uncertainty in the forecasting process, due in part to the complexity of the operating environment along with model/parameter uncertainty. This is mitigated by considering alternative scenarios for the assumptions used and subjecting the baseline forecasts to various shocks. A key output of the forecasting process is an assessment of risks over the policy horizon as well as confidence intervals for key variables, typically shown as fan charts.

The increased role of judgment and risk assessment in the forecasting process warrants further improvements. Recent research has shown that the combination of model-based and judgment-based forecasts have performed relatively well in terms of out-of-sample forecasting. The role of subjective judgement in forecasting is particularly useful during unusual events (e.g., oil crisis, currency crisis, terrorist attack, etc.) in which estimation of the impact could require more information to complement historical statistics [Sims 2002]. Thus, a more formal framework on how to combine various model forecasts and expert judgment of the staff and policymakers could lead to improvements in the central bank's analytical capacities [Adolfson et al. 2007].[1]

This paper summarizes the main features of the process involved in generating the baseline forecasts, alternative scenarios, and policy simulations in the BSP. We highlight the complementary roles played by the BSP's suite of models and the expert judgement from both the sector specialists and top officials as well as the importance of sufficiently communicating the inflation outlook and risks in improving the transmission of monetary policy. We also present a systematic evaluation of the forecasting performance of the BSP from 2010 to 2020 together with some of the lessons in forecasting during the COVID-19 pandemic and the recent efforts to improve the BSP's suite of macroeconomic models.

2. Forecasting and Policy Analysis System (FPAS)

The FPAS is the standard framework adopted by many IT central banks to systematically organize monetary policy decision-making [Clinton et al. 2017]. IT central banks in the 1990s pioneered the systematic use of tools and processes in setting their interest rates. The framework covers the efficient provision and generation of all economic information, including forecasts for and policy simulations on macroeconomic variables, relevant to monetary policy formulation. It also provides guidance on the organizational structure of the forecasting team, sources of external assumptions, schedule of deadlines and meetings for each forecast exercise, database management, and information technology requirements.

[1] Adolfson et al. [2007] illustrated specific episodes when expert judgment complemented model-based forecasts at the Sveriges Riksbank (the central bank of Sweden). For instance, in Q2 2002, the official forecasts of Riksbank incorporated the sector experts' view that the food price increases due to the mad cow and foot and mouth diseases represent a persistent shock to price level but small effects in annual inflation. In contrast, the purely model-generated forecasts from DSGE overestimated the impact of food price shock to inflation in 2001 and 2002.

Laxton et al. [2009] identified the benefits of establishing an FPAS. This includes improved internal communications between the staff, management, and policy decision-makers, ease in identifying and communicating policy issues, enhanced ability to systematically review the previous forecast and policy decisions, development of technical skills of bank personnel involved in surveillance, forecasting, and policy analysis, improvements in institutional knowledge, and greater transparency behind the monetary policy decisions.

The framework involves the following major components (Adrian et al. [2018]; Mæhle et al. [2021]):

1. Establish a forecasting team responsible for model development, near-term forecasting (current and one-quarter ahead), and medium-term forecasting.
2. Develop a reporting system based on a key set of macroeconomic variables so that everyone involved in the process will be informed about how new information affects the near-term inflation forecast and the implications if any for the longer-term outlook.
3. Develop a projection model of the economy that embodies policymakers view about the monetary policy transmission mechanism in the standard set of shocks that affect the economy.
4. Develop a consistent model-based macroeconomic forecast. This includes assessing the risks to the previous official baseline forecast and using that to propose changes to the official baseline forecast.
5. Develop measures of uncertainty in the forecast such as model-based confidence intervals. These measures should be used to communicate the extent of this uncertainty both internally and to the public.
6. Study specific risks in the baseline forecast in developing contingency plans for reacting to new information.

2.1. Features of the BSP FPAS

Figure 1 illustrates the informal FPAS of the BSP. This covers the overall process for economic surveillance, generation of near-term and medium-term macroeconomic forecasts, and risk assessment in support of monetary policy analysis and formulation at the BSP.

2.2. Monetary policy analysis at the BSP[2]

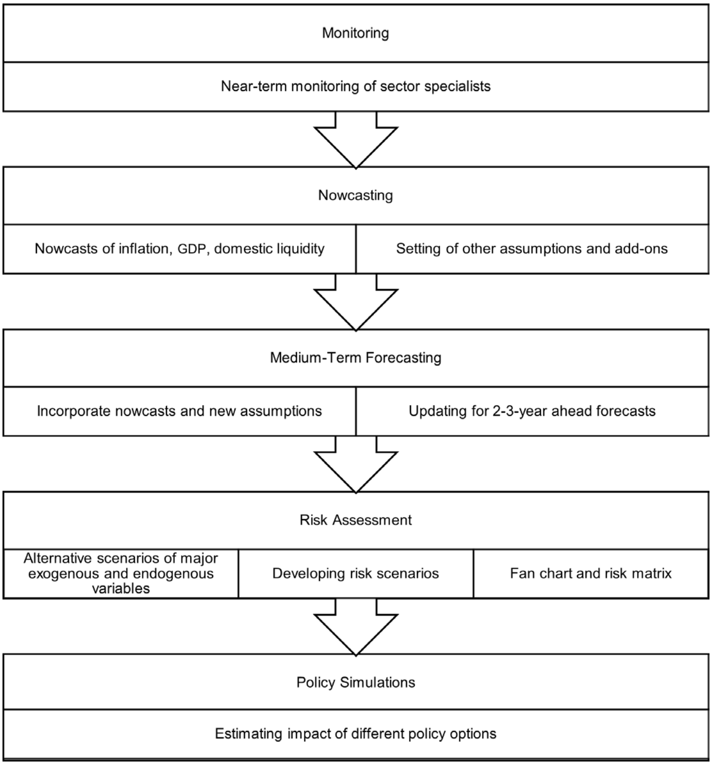
Monetary policy analysis at the BSP is non-linear and iterative with the end goal of generating a comprehensive and coherent narrative on factors underpinning the policy decision. The forecasting process starts about a month before the Monetary Board (MB) monetary policy meeting. The Technical Staff

[2] Please refer to the FAQ on Inflation Targeting for a more detailed description of the inflation targeting framework of the BSP available online ["The BSP and Price Stability" 2020].

(TS) of the BSP's Advisory Committee (AC)[3] comprising of sector experts, meets to discuss recent developments and possible risks in the key economic sectors that influence the outlook for inflation and growth in the country. Information from these discussions is incorporated by the DER forecasting team in the baseline projection and risk assessment. The inflation outlook and alternative scenarios are finalized when the TS reconvenes about two weeks after.

During the second technical level meeting, the DER forecasting team may be asked to revise its baseline estimates to incorporate the consensus view of the TS on the inflation outlook. The risks collectively identified by the TS will then be simulated using the BSP economic models to quantify their likely impact on the baseline projections. Table 2 shows a typical timeline of meetings on monetary policy analysis at the BSP.

FIGURE 1. BSP informal FPAS



Source: Authors.

[3] The AC was formed as part of the institutional setting for inflation targeting. It is tasked to deliberate, discuss and make recommendations on monetary policy to the MB. The AC is composed of seven members and chaired by the BSP Governor. The other members include the Deputy Governors of the Monetary and Economics Sector, Corporate Services Sector, Financial Supervision Sector, and the Senior Assistant Governors of the Monetary Policy Sub-Sector, Financial Markets, and Office of Systematic Risk Management.

TABLE 2. Timeline of meetings

Week	Meeting	Discussions
1-2		Topics arising from the last AC/MB meeting
3	TS Meeting: recent developments and issues	Domestic and global economic conditions Research on key issues of concern
4-5	TS Meeting: forecasts	Discuss preliminary forecasts, risks, and policy recommendations to AC
5-6	AC Meeting MB Policy meeting	Discuss forecasts and risks Policy recommendation to the MB Announce policy decision, forecasts, and balance of risks

Source: Authors.

The assessment of the TS on current macroeconomic conditions, baseline forecasts of key macroeconomic variables and risks surrounding the outlook as well as its policy recommendation are then presented to the AC during its scheduled policy review meeting. During the said meeting, the members of the AC will deliberate on the TS submissions and decide on their monetary policy recommendation to the MB. Members of the AC can suggest refinements to the forecasts or request additional scenario-building exercises or policy simulations to fully incorporate its view on the direction of the macroeconomy over the policy horizon. The policy recommendation of the AC is then submitted for discussion during the MB's monetary policy meeting. Once approved by the MB during its monetary policy meeting, the staff forecasts are then considered as the BSP's official forecasts, released to the public at the BSP's press conference on monetary policy decision.

TABLE 3. BSP's suite of models

Purpose	Model
Nowcasting	Inflation: SARIMAX, Regional, State Space GDP: ARIMA, Bridge Equations, Bayesian VAR, Composite Leading Indicators M3: ARIMA, VAR, LFS Current Account: ARIMA, MIDAS, Bridge Equations
Medium-term forecasting Scenario-building Policy simulations	Multi-Equation Model (MEM) Single Equation Model (SEM) Policy Analysis Model for the Philippines (PAMPH) Global Projection Model (GPM)
Add-ons and other policy simulations	Input-Output Table Global Integrated Monetary and Fiscal Model (GIMF)
Other models	Output Gap and Potential Output Models Early Warning System for Currency Crisis and Debt Sustainability Philippine Composite Index of Financial Stress

Source: Authors.

The BSP maintains a suite of models for forecasting and policy simulations with a view that no single and superior model could accurately forecast the exact path of economic variables or address all policy issues. This approach also recognizes the inherent trade-off between model tractability and model size and depth that allow for richer structural features. In recognizing these limitations, the suite-of-models approach offers flexibility to address different policy issues and forecasting requirements of monetary policy analysis. The BSP suite of models includes models used for near-term forecasting or nowcasting, medium-term forecasting, scenario building and policy simulations (Table 3).

2.3. Nowcasting models

Nowcasting models were developed to supplement the BSP's medium-term forecasting models. The forecasts from nowcasting models are considered as initial conditions when generating the forecasts from the medium-term forecasting models. By providing a clearer picture of the state of the current quarter or current month than what is officially available due to lags in data releases, the use of nowcasts as initial conditions lead to improvements in medium-term forecast performance. The following describes the various nowcasting models that are currently in operation at the BSP.

2.3.1. Inflation

The Disaggregated Seasonal Autoregressive, Integrated, Moving Average (SARIMA) model with exogenous variables generates 1- to 3-month ahead forecasts for 30 select sub-components of the CPI. The sub-component forecasts are then combined to produce estimates for headline, core, and other inflation measures. Using a Seasonal Autoregressive Integrated Moving Average process with exogenous variables (SARIMAX), forecasts are derived from the univariate analyses of historical movements along with occasional structural features and seasonal factors. Some equations are supplemented by higher-frequency data on the actual domestic prices of agricultural commodities, petroleum products and electricity. Estimates from the model provide a more detailed and components-based approach to analyzing inflation outcomes [Allon 2015].

The Regional Inflation Model forecasts headline inflation at the regional level to gain a more granular perspective on the price dynamics across the 17 regions in the country. The model uses the univariate and multivariate support vector regression (SVR) algorithm, which is a machine learning model that is capable of both linear and non-linear regressions. Unlike the standard ordinary least squares approach, SVR offers more flexibility by directly specifying an acceptable tolerance level for the error term in the estimation. Meanwhile, the multivariate SVR extends the analysis by including a dummy variable for a supply shock as assessed through news analysis and expert judgement [Gabriel et al. 2020].

The state-space model provides nowcasts for headline and core inflation via time-varying regressions written in state-space form. The selected explanatory variables for headline inflation are weekly price variables that represent potential shocks to major components of the CPI. Meanwhile, regressors for core inflation are demand-based indicators that reflect long-term trends in economic fundamentals rather than transitory price fluctuations. The state-space specification then captures non-linearities in the relationships (i.e., coefficients) of the inflation measures and their high-frequency explanatory variables through the use of the Kalman filter as well as the simultaneous estimation of observed and unobserved variables (Allon et al. [forthcoming]).

2.3.2. GDP growth

The quarterly GDP growth nowcast that feeds into the forecasting models of BSP is a consolidated forecast derived from different nowcasting methods. The methods considered for projecting the quarter-ahead GDP growth include: autoregressive models at the major industry and expenditure level; ordinary least square regression using frequently (i.e., monthly) released contemporaneous and leading indicators of GDP. Indicators used in the models are total and industrial electricity sales, manufacturing volume of production index, national government revenue and expenditure, and passenger car sales from Chamber of Automotive Manufacturers of the Philippines, Inc. (CAMPI). The models also consider a dummy variable for elections in industries positively influenced by election-related activities.

Forecasts from each model are aggregated using the inverse of the mean square error derived from the forecasted and actual values. The results from these models along with staff judgment based on recent trends in high-frequency indicators are used as the one quarter-ahead projection. These models undergo regular updating and refinement. A more sectoral GDP nowcasting using industry-related indicators is preferred to provide a detailed analysis of the factors driving the GDP forecasts. For example, data on overseas Filipino (OF) remittances, foreign trade statistics imports of consumer goods, and total number of employed persons are used as indicators to nowcast household final consumption expenditure.

2.3.3. Domestic liquidity

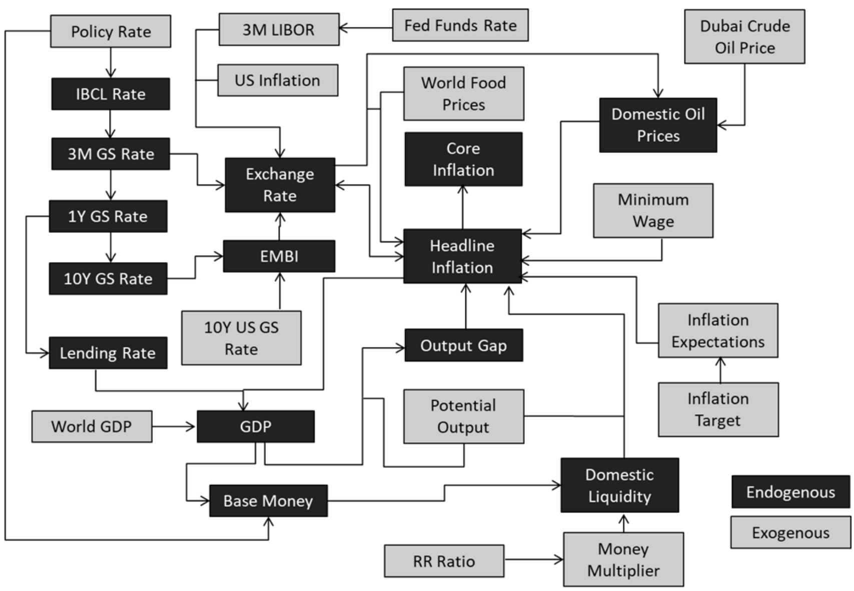
Various nowcasting models are also used to enhance the short-term forecasting performance of M3 growth. These time series models are based on high-frequency indicators, such as placements in the BSP's liquidity facilities, government deposits in the BSP, and other financial market variables. Alternative estimates of the money multiplier are also used to generate alternative forecasts of M3 in different states. The average of these nowcasts is used as initial conditions for the M3 growth forecasts over the policy horizon.

2.4. Workhorse models

The Multi-Equation Model (MEM) and Single Equation Model (SEM) are the BSP's workhorse models for macroeconomic forecasting and policy simulations. These were developed together with Dr. Roberto S. Mariano of the University of Pennsylvania in 1997 and 2013, and have been reviewed and refined by the staff thereafter. Details on the earlier version of MEM and SEM along with an evaluation of their forecast accuracy were explained in Guinigundo [2005].

The MEM is a system of equations aimed at providing a comprehensive view of the macroeconomic outlook over the policy horizon by capturing the main aspects of monetary transmission in the country. The MEM consists of simultaneous equations, estimated largely using the error-correction mechanism (ECM), and other identities. The key relationships in the model are described in Figure 2. The equation for monthly year-on-year (Y-O-Y) inflation is the primary equation in the MEM. Under this structure, the long-run price level follows the quantity theory of money, augmented by supply-side variables, such as nominal wages, oil prices, and non-oil prices. Meanwhile, the short-run dynamics is determined by both supply-side and demand-side variables as well as inflation expectations. Other important equations in the MEM relate to GDP growth, domestic liquidity, exchange rate, and market interest rates.

FIGURE 2. Schematic diagram of the MEM



Source: Authors.

External variables, like world GDP growth, foreign interest rates, international food prices, and Dubai crude oil prices are treated exogenously in the MEM. World GDP growth follows the trade-weighted average of the country's major trading partners. The growth assumptions for each trading partner as well as the path of international food prices are based on the projections from the IMF's World Economic Outlook (WEO) and Global Projection Model Network (GPMN). In addition, foreign interest rates and Dubai crude oil prices are assumed to follow the futures market. Shocks in the external sector affect inflation directly and indirectly. Higher international oil and food prices directly lead to higher inflation. Higher world GDP growth leads to higher domestic GDP growth, which boosts aggregate demand and leads to higher inflation. Higher foreign interest rates impact the interest parity condition, which could lead to depreciation of the peso and higher inflation.

The SEM specifies the monthly Y-O-Y inflation as a cointegrating relationship with a short-run ECM. Because the SEM is equivalent to the inflation equation in the MEM, it can be considered as the reduced-form version of the MEM. This results in a more consistent modelling approach between the two models. The major equations and identities of the MEM are shown in Table 4.

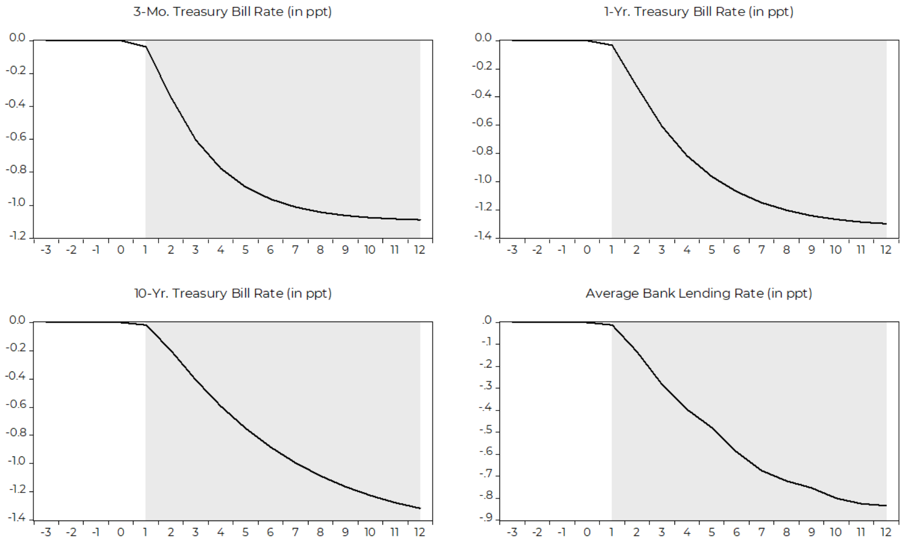
TABLE 4. Major equations and identities of the MEM

Variable	Long-run	Short-run
Inflation (π_t)	$\log cpi_t = \gamma_0 + \gamma_1 \log (m3_t/gdp_t) + \varepsilon_t$	$\pi_t = f\,(oil_t, nonoil_t, er_t, wages_t, gdp_t^{gap}, tbond_t^{10y} - tbill_t^{1y}, \pi_t^e - \pi_t^{target})$ w/lags $+ \mu\varepsilon_{t-1}$
Interest rates	$tbill_t^{3m} = \gamma_0 + \gamma_1\, wmo_t + \epsilon_t$	$\Delta tbill_t^{3m} = \beta_1\, \Delta wmo_t + lags - \mu\varepsilon_{t-1}$
	$tbill_t^{6m} = \gamma_0 + \gamma_1\, tbill_t^{3m} + \varepsilon_t$	$\Delta tbill_t^{6m} = \beta_1\, \Delta tbill_t^{3m} + lags - \mu\varepsilon_{t-1}$
	$tbill_t^{1y} = \gamma_0 + \gamma_1\, tbill_t^{6m} + \varepsilon_t$	$\Delta tbill_t^{10y} = \beta_1\, \Delta tbill_t^{6m} + lags - \mu\varepsilon_{t-1}$
	$tbond_t^{10y} = \gamma_0 + \gamma_1\, tbond_t^{1y} + \varepsilon_t$	$\Delta tbond_t^{10y} = \beta_1\, \Delta\gamma_1\, tbond_t^{1y} + lags - \mu\varepsilon_{t-1}$
	$lending_t = \gamma_0 + \gamma_1\, wmo_t + \varepsilon_t$	$\Delta lending_t = \beta_1\, wmo_t + lags - \mu\varepsilon_{t-1}$
Base money (rbm_t)	$\log rbm_t = \gamma_0 + \gamma_1 \log (gdp_t) + \varepsilon_t$	$\Delta \log rbm_t = \beta_1 \Delta_{12} \log (gdp_t)$ w/lags $+ \beta_2\, real\ wmo_t/lags + \mu\varepsilon_{t-1}$
Oil prices (oil_t)	$\log oil_t = \gamma_0 + \gamma_1 \log (dubai_t \times er_t) + \varepsilon_t$	$\Delta \log oil_t = \beta_1\, \Delta \log (dubai_t \times er_t)$ w/lags $+ \mu\varepsilon_{t-1}$
Other equations and identities		
GDP growth	$\Delta_{12} \log gdp_t = \beta_1 + \beta\Delta_{12} \log gdp_t$ w/lags $+ \beta\Delta_{12} \log wgdp_t$ w/lags + real interest rate lags $+ \epsilon_t$	
Output gap	$gdpgap_t = \log gdp_t - \log gdp_t^{potential}$ Potential output estimated via one-sided Hodrick-Prescott filter	
Exchange rate	$\Delta \log er_t = -(i_t - \pi_t) + (i_t^{US} - \pi_t^{us}) + \Delta \text{riskpremia}_t$	
Domestic liquidity	$m3_t = mm_t \times bm_t$	

Source: Authors.

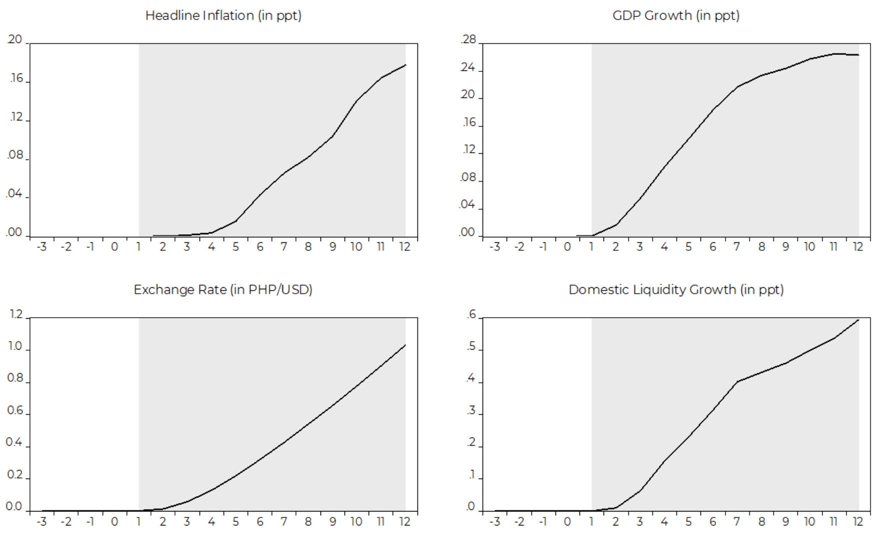
In the MEM, changes in the policy rate affect the economy through the standard transmission channels of monetary policy, i.e., interest rate, credit, exchange rate, and expectations. An easing of the policy rate is projected to result in lower market interest rates (Figure 3), faster domestic liquidity growth, a depreciation in the exchange rate, and higher GDP growth and inflation (Figure 4). However, over the forecast horizon, the BSP policy rate is assumed to remain at its current level.

FIGURE 3. Impact of a 100-bp policy rate easing on market interest rates



Source: BSP estimates.

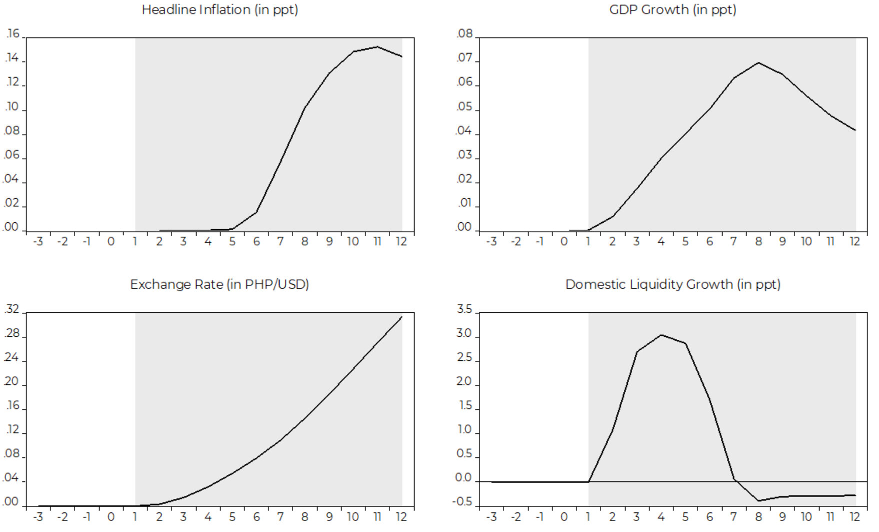
FIGURE 4. Impact of 100-bp policy rate easing on macroeconomic variables



Source: BSP estimates.

Meanwhile, a reduction in the reserve requirement ratio (RRR) leads to a corresponding increase in the money multiplier which raises domestic liquidity and inflation via the standard quantity theory of money identity. RRR adjustments affect the major macroeconomic variables with a lag, wherein the peak impact occurs after about four to six quarters (Figure 5).

FIGURE 5. Impact of a 100-bp RRR reduction on macroeconomic variables



Source: BSP estimates.

2.5. Expert judgement

The models are not mechanically employed to produce the macroeconomic forecasts. Instead, the generation of the inflation outlook benefits from the careful surveillance and monitoring activities of DER sector specialists. Key developments that could influence the outlook for inflation and growth are incorporated as either add-ons to the baseline forecast or as inflation risks, depending on the probability assigned by the AC TS. Meanwhile, the expected impact of highly probable events that were not captured by the models (e.g., implementation of tax reforms), due to the inherent limitations of econometric models, are incorporated as add-ons in the baseline forecasts.

Consistent with the practice of flexible inflation targeting, the DER endeavors to provide a comprehensive assessment of the price environment in the baseline forecast and risk assessment. DER surveillance activities cover various sectors in both supply and demand side of inflation. On the supply side, developments in the agriculture and oil market, among others, are closely monitored given their large weights in the Philippine CPI basket and their considerable impact on inflation expectations [Españo and Santillan 2018]. On the demand side, domestic economic activity and external demand, along with liquidity conditions, are given a lot of focus. The DER is also watchful of possible early signs of second-round effects to check whether inflation pressures are becoming entrenched in the price dynamics.

At the same time, the DER leverages its representation in key committees and assessment of multilateral institutions.

- The TS regularly engages with counterparts from government agencies with direct involvement in sectors of importance to the price dynamics. This includes the Department of Agriculture (DA), Department of Energy (DOE), Department of Trade and Industry (DTI), Department of Labor and Employment (DOLE), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), and Land Transportation Franchising and Regulatory Board (LTFRB) among others.
- The sector experts also interact with industry and consumer groups through inter-agency meetings such as the National Price Coordinating Council and the National Wages and Productivity Commission. Insights from discussions with the National Food Authority (NFA) Council, Committee on Tariff and Related Matters (CTRM), and Export Development Council (EDC) are incorporated in the assessment as needed.
- On the analysis of the global oil market, which influences heavily trends in domestic energy prices, the TS relies heavily on the assessment of the International Energy Agency (IEA), US Energy Information Agency (EIA), Organization of the Petroleum Exporting Countries (OPEC), and IMF along with market reports from Capital Economics, and Oxford Economics.
- The TS also attends the regular meetings of the GPMN to track the latest developments in global economic conditions and global economic prospects, supplemented with analysis from the IMF.

More importantly, the AC and MB are part of the assessment process with the narrative on the inflation outlook and risks representing the consensus view. Details on all the assumptions used to generate the baseline forecasts as well as risks to the inflation outlook are carefully presented to the AC and MB during the regular review of the BSP monetary policy. Comments and clarifications on these assumptions are addressed and taken into consideration in the subsequent review/update of the inflation forecasts to ensure that the inflation forecasts and risks announced to the public represent the views and assessment of BSP policymakers.

2.6. Risk assessment

The forecasting team, together with the TS, evaluates the sensitivity of the baseline forecasts to various paths of the major exogenous variables, such as crude oil prices and world GDP growth. The baseline estimate is also subjected to shocks, implied by historical data, to determine the range of variability underpinned by the forecasts.

In addition, the TS considers different scenarios that pertain to upside and downside risks to the inflation outlook, which is summarized in a risk matrix (Table 5). The various scenarios are then assigned probability values based on the discussion at the technical level meeting involving the forecasting team and sector specialists. The outlook of other multilateral institutions as well as information gathered during inter-agency meetings are considered in determining the probabilities. Scenarios that have more than 75 percent probability of taking place over the forecast horizon are incorporated in the baseline. The estimated impact of each scenario is then multiplied by the assigned probabilities. The sum of the weighted impact for each year will indicate whether the risks to the outlook are balanced, on the upside, or on the downside.

TABLE 5. Risk matrix

Risks	Probability	Weighted impact
Upside Downside	Low (25%) Medium (50%) High (75%)	Probability-weighted impact of risks

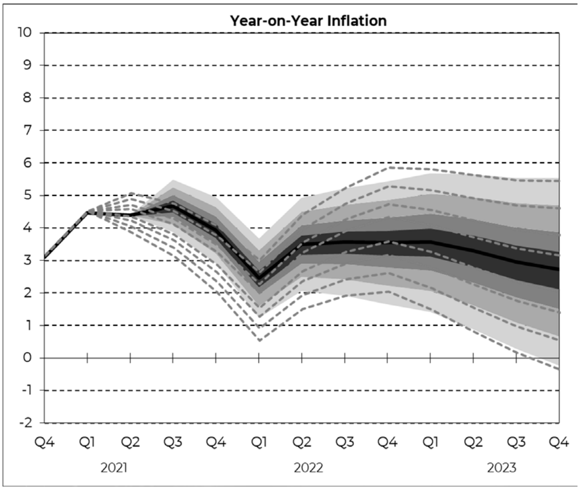
Source: Authors.

The balance of risks to the outlook are graphically presented using a fan chart (Figure 6).[4] The fan chart shows the probability of various outcomes for inflation over the forecast horizon. The darkest band depicts the central projection, which corresponds to the BSP's baseline inflation forecast. It covers 25 percent of the probability distribution. Each successive pair of bands is drawn to cover a further 25 percent probability until 75 percent of the probability distribution is covered. Lastly, the lightest band covers the lower and upper 90 percent of the probability distribution. The bands widen (i.e., "fan out") as the time frame is extended, indicating increasing uncertainty about outcomes. The band in wire mesh depicts the inflation profile in the previous report.

The shaded area measures the range of uncertainty which is based on the deviation of forecasts from actual outcomes in the past years. The relative magnitude of the probability areas lying above and below the central projection captures the level of skewness based on the downside and upside shocks that affect the inflationary process over the next two years.

[4] Central banks, such as the Bank of England (BOE) and the Czech National Bank (CNB), publish fan charts in their reports. CNB [2008] provides a detailed explanation on the methodology for construction of fan charts.

FIGURE 6. Fan chart



Source: BSP estimates.

3. Forecast evaluation

In the following sections, we provide the results of the systematic evaluation of the BSP's inflation forecasting performance. This exercise evaluates the month-ahead inflation projection from 2010 to 2020 published on the last working day of the month in the BSP's website and social media accounts as well as the annual inflation forecasts presented in the monetary policy meetings in 2019 and 2020 (Section 3.1). Moreover, statistical tests are performed on the 1-, 3-, 6-, and 12-month ahead inflation forecasts of the BSP for the period 2010 to 2020. In benchmarking the 6-month ahead forecasts, the BSP's full-year inflation forecast during the June monetary meetings of each year are compared against the private sector's full-year inflation forecast every June survey and the IMF's full-year inflation forecast during the release of the WEO every April (Section 3.2).[5]

Results of formal statistical tests show no bias or consistent pattern in the forecast errors of the BSP's inflation models. The BSP SEM/MEM does not consistently overpredict or underpredict inflation. The BSP's inflation forecasts are unbiased for 2016 to 2020 at forecast horizons ranging from 1-, 3-, 6-, and 12-months ahead.

Results also indicate that the inflation forecasts produced by the BSP are generally accurate, and efficient over the relevant forecast horizons. In addition, improvements in the performance were noted from 2016 to 2020 relative to the

[5] Meanwhile, the 1-year [2-year] ahead annual inflation forecast comparison refers to the following: (i) BSP's full-year inflation forecast during the December MB meetings of the previous year [two years] (i.e., the annual forecast for 2010 [2011] was the forecast presented in the December 2009 MB meeting); (ii) private sector's full-year inflation forecast every December survey of the previous year [two years] (i.e., the annual forecast for 2010 [2011] was the forecast in the December 2009 private sector economists survey); IMF's full-year inflation forecast during the release of the WEO every October of the previous year [two years] (i.e., the annual forecast for 2010 [2011] was the forecast in the October 2009 WEO).

full sample. Finally, the BSP's inflation forecasts have generated lower forecast errors relative to the private sector and IMF for the 6-month to 2-year ahead horizons, which are the relevant forecast horizon for monetary policymaking.

The model-fitted forecasts with add-ons were also closer to actual inflation outturns relative to projections presented during the preceding December monetary policy meetings for the periods 2018 to 2020. This indicates that the model is able to reasonably capture the inflation dynamics as the forecast errors decline after accounting for the actual values of the add-ons along with other explanatory variables. There are inherent residual forecast errors that reflect parameter uncertainty, especially for example with the significant structural break caused by the pandemic, as well as gaps in a parsimonious model specification.

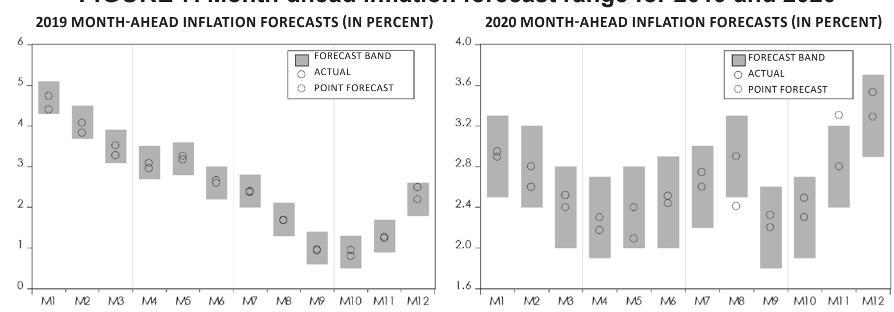
Lastly, the practice of supplementing the pure model results with estimated add-ons based on market surveillance improves the performance of the final forecasts. The generation of the inflation outlook benefits from the careful surveillance and monitoring activities of DER sector specialists.

3.1. Forecasting performance for 2010-2020

3.1.1. Month-ahead inflation forecasts

For the period 2010 to 2020, actual inflation has settled within the month-ahead inflation forecast band 122 times out of 132 months (92.4 percent). In 2019, actual inflation fell within the forecast band in all 12 months of the year. Meanwhile, monthly inflation in 2020 settled within the forecast range ten out of 12 months (Figure 7).

FIGURE 7. Month-ahead inflation forecast range for 2019 and 2020

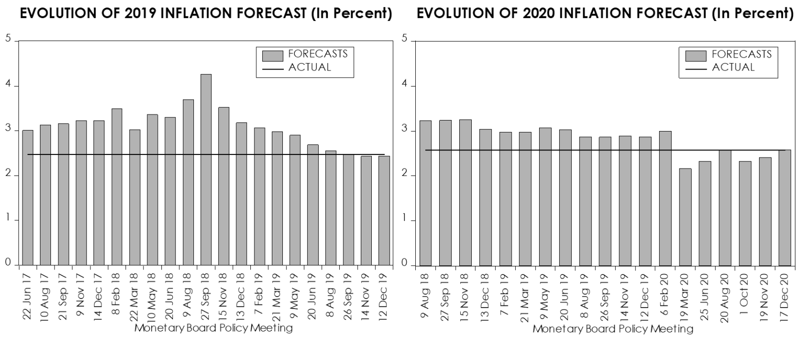


Source: BSP estimates.

3.1.2. Annual inflation forecasts for the Monetary Board policy meetings

Average inflation settled at 2.5 percent in 2019. The annual inflation forecasts for 2019 presented during the monetary policy meetings of the MB ranged from 2.4 to 4.3 percent with an average of 3.1 percent (Figure 8). These forecasts were generally higher compared to the actual outturn but improved notably over the forecast horizon as more information became available.

FIGURE 8. Annual inflation forecasts for 2019 and 2020

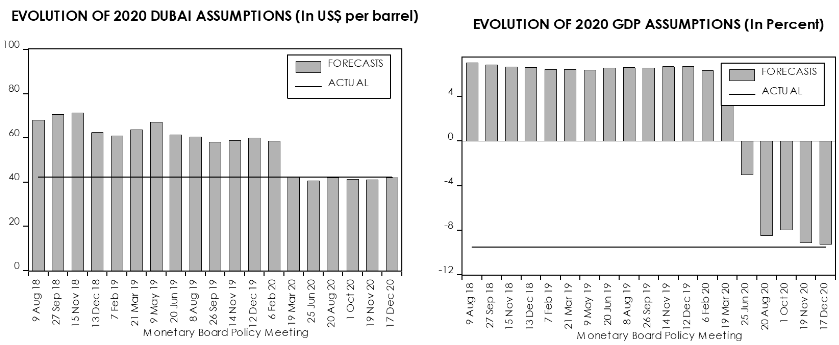


Source: BSP estimates.

The forecasts during the policy meetings from June 2017 to February 2019 were higher due mainly to how the impact of the Rice Tariffication Law (RTL) was reflected. Initially, the impact of the RTL was only factored in as a downside risk in the risk matrix. The RTL was then incorporated in the baseline forecasts after the passage of the law in March 2019. Consequently, the inflation forecasts in the succeeding policy meetings trended downwards to approach actual inflation.

Average inflation for 2020 remained broadly stable at 2.6 percent. The annual forecasts for 2020 presented during the policy meetings ranged from 2.2 to 3.3 percent with an average of 2.8 percent. The initial forecasts presented during the August 2018 to February 2020 policy meetings were relatively higher than actual inflation since the forecasts were made before the COVID-19 pandemic (Figure 8). The resulting contraction in both global and domestic economic activity along with lower global crude oil prices resulted in the significant downward adjustment in the inflation forecasts for 2020 by March 2020 (Figure 9). Despite the uncertainty caused by the pandemic, the full-year inflation forecasts from March to December 2020 remained relatively close to actual inflation with the annual forecasts ranging from 2.2 to 2.6 percent.

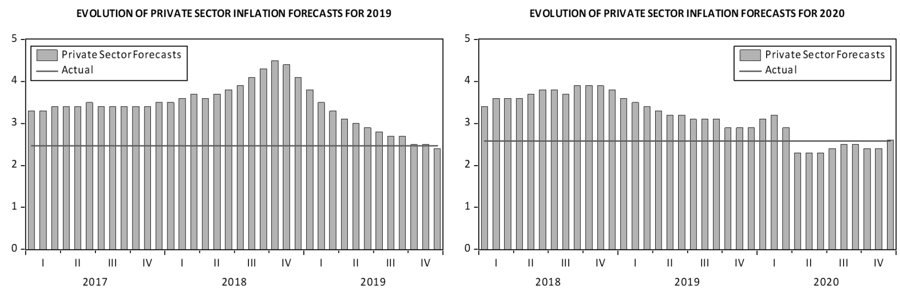
FIGURE 9. Main sources of forecast errors



Source: BSP estimates.

Meanwhile, the inflation forecasts for 2019 of private sector economists surveyed by the BSP were consistently higher compared to the actual inflation outturn throughout the monthly survey rounds. The 2019 inflation forecasts from the private sector ranged from 2.4 percent to 4.5 percent with an average of 3.4 percent. Similarly, the private sector inflation forecasts for 2020 that were made prior to the pandemic were significantly above the actual outturn. During the January 2017 to February 2020 survey periods, the private sector forecasts ranged from 2.9 percent to 3.9 percent with an average of 3.4 percent. Their forecasts were revised downwards from March to December 2019 ranging from 2.3 to 2.9 percent with an average of 2.5 percent (Figure 10).

FIGURE 10. Private sector inflation forecasts for 2019 and 2020



Source: BSP estimates.

3.2. Statistical tests of forecasting performance

The evaluation of the BSP's inflation forecasting performance across different forecasting horizons was assessed in terms of the following criteria: (1) accuracy, (2) unbiasedness, (3) efficiency, and (4) benchmarking. Bank of England [2015] indicates that while the aforementioned statistical tests are not independent from each other (i.e., more efficient use of available information could improve forecast accuracy), evaluating the forecast performance in various perspectives could prove useful in the refinement of the forecasting process.

3.2.1. Accuracy

How close are the inflation forecasts from their actual outturns? What is the forecasting horizon where inflation forecasts can be made with an acceptable level of precision?

BSP forecasts are generally accurate. The forecast errors, as measured by the mean absolute error (MAE) and root mean squared error (RMSE), tend to increase with longer forecast horizons. Nevertheless, the forecasts generated from the BSP's models perform better compared to a benchmark random walk model.[6]

[6] The accuracy of the BSP's inflation forecasts was compared to a naïve model, which was specified as a weighted average of the current and three previous observations of inflation [Duncan and Martinez-Garcia 2018].

The BSP macro models outperform a random walk model of inflation across forecast horizons of one month to 12 months ahead in terms of both MAE and RMSE. Moreover, the errors from the BSP's forecasts have trended downwards in the past five years (Table 6).

TABLE 6. Forecast accuracy comparison

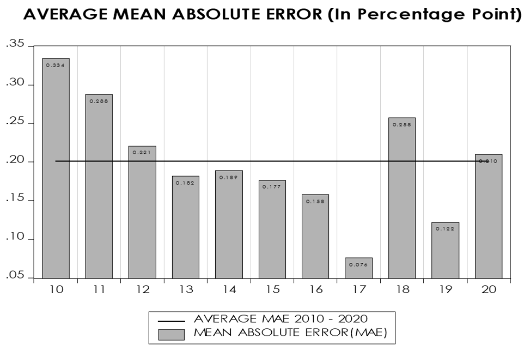
Months ahead	Sample: 2010-2020				Sample: 2016-2020			
	MAE		RMSE		MAE		RMSE	
	BSP	Random walk model	BSP	Random walk model	BSP	Random walk model	BSP	Random walk model
1	0.20	0.32	0.26	0.41	0.16	0.33	0.21	0.43
3	0.60	0.72	0.77	0.90	0.49	0.80	0.65	0.99
6	0.81	1.06	1.02	1.31	0.72	1.13	0.92	1.42
12	0.94	1.57	1.21	1.94	0.95	1.73	1.25	2.12

Source: BSP estimates.

In addition, the BSP's inflation forecasts are found to have a statistically adequate level of precision for up to 12 months ahead as captured by the forecast memory. The forecast memory measures the longest horizon wherein the inflation forecasts can be considered acceptable [Andersson et al. 2007]. More formally, the forecast memory is defined as the longest horizon where the RMSE is lower than the standard deviation of the series. The BSP's inflation forecasts up to 12 months ahead have an adequate level of precision since the standard deviation of inflation from 2010 to 2020 is 1.42 percent.

The BSP's forecasting performance has also generally improved. The MAE of BSP 1-month ahead inflation forecasts has consistently declined since 2010, although a slight uptick was observed in 2018 driven by the impact of the TRAIN Act along with higher-than-assumed global crude oil prices, the unanticipated increase in rice prices, higher-than-projected peso depreciation; and in 2020 due mainly to economic shock owing to the global pandemic (Figure 11).

FIGURE 11. MAE of inflation forecasts from 2010 to 2020



Source: BSP estimates.

3.2.2. Unbiasedness

Do the inflation forecasts consistently overestimate or underestimate actual outturns, i.e., are the forecast errors systematically positive or negative?

The unbiasedness of the inflation forecasts could be tested by regressing the forecast errors against a constant term (Equation 1).

$$\pi_t - \pi^f_{t,h} = error_{t,h} = \beta_0 + \varepsilon_t \tag{1}$$

where h = 1,3,6,12-month ahead forecasts.

- If $\beta_0 = 0$, then the forecasts are unbiased.
- If $\beta_0 < 0$, then the forecasts are systematically higher than actual inflation.
- If $\beta_0 > 0$, then the forecasts are systematically lower than actual inflation.

The results of the test indicate that there is no consistent pattern in the forecast errors of the BSP's inflation forecasts. It does not consistently overpredict or underpredict inflation, which could lead to a certain bias or direction in terms of policy recommendation. In fact, the unbiasedness of BSP's inflation forecasts has improved in more recent periods.

Using a sample from 2010 to 2020, there is evidence that the BSP's 3-month and 6-month ahead forecasts were higher than actual outturns. This could be attributed to the previous practice of including add-ons to the baseline forecast over the near term of risks that have not yet materialized. This was done for example for possible transport fare and electricity rate adjustments, which resulted in overestimated forecasts.

However, performing the same test for the period 2016 to 2020 suggests that the upward bias has dissipated across the 1-month, 3-month, 6-month, and 12-month ahead horizons. During this period, the BSP staff only incorporates the add-ons on the impact of factors that are not captured by the model when the price adjustments are already certain.[7] Near-term risks that are not reflected in the baseline forecasts are then included in the risk matrix, with the attached probability level determined by the AC Technical Staff (Table 7).

TABLE 7. Test for unbiasedness

Months ahead	2010-2020				
	β_0 Coefficient	p-value		β_0 Coefficient	p-value
1	-0.02	0.39		0.01	0.64
3	-0.25	0.00	***	0.02	0.86
6	-0.28	0.00	***	0.01	0.94
12	-0.21	0.06		-0.06	0.71

*** Significant at the 1 percent level.
Source: BSP estimates.

[7] For instance, the impact of the RTL on inflation was not incorporated directly in the baseline forecast while the bill was still being deliberated. Its impact was only reflected once the law was officially approved to avoid any downward bias in the baseline forecast emanating from the uncertainty of the timing and magnitude of the lower rice prices.

3.2.3. Efficiency

Do the inflation forecasts reflect all available information during the time the forecasts were made, i.e. can the forecasts be scaled up or down to be closer to the actual outturns?

The efficiency of the forecasts can be tested using the Mincer-Zarnowitz [1969] approach by regressing actual inflation outturns with the forecast (Equation 2):

$$y_t = \beta_0 + \beta_1 \, y_t^{t-h} + \varepsilon_t \qquad (2)$$

where h = 1,3,6,12-month ahead forecasts.

If $\beta_0 = 0$ and $\beta_1 = 1$, then it means that the forecasts are not statistically different from actual inflation. However, if $\beta_0 = 0$ and $\beta_1 \neq 1$, then the forecasts errors could have been improved by scaling the forecasts up or down.

Similar to the test for unbiasedness, the efficiency of BSP's inflation forecasts has improved in recent years. The tests indicate that the forecasts are efficient across relevant forecast periods, using sample data for the period 2016 to 2020. This marks an improvement compared to the test results for the longer sample starting 2010 (Table 8).

TABLE 8. Test for efficiency

Months ahead	2010-2020				
	β_1 Coefficient	p-value		β_1 Coefficient	p-value
1	0.97	0.21		1.00	0.88
3	0.86	0.00	***	1.00	0.98
6	0.76	0.00	***	1.09	0.77
12	1.09	0.15		1.82	0.13

*** Significant at the 1 percent level.
Source: BSP estimates.

3.2.4. Benchmarking

How does the BSP's inflation forecasts compare with the performance of forecasts from a simple time series model, the private sector, and other organizations?

Table 9 indicates that the BSP's forecast errors of annual inflation from 6-month, 1-year, and 2-years ahead for the period 2010-2020 are comparatively lower compared to forecasts from the private sector and the IMF.

While private sector forecasts are generated independently, empirical studies showed that the BSP's inflation forecasts influence the formation of the private sector's inflation expectations. Españo and Santillan [2018], following the inflation expectations model by Cerisola and Gelos [2005], found that the forward-looking indicators for inflation (i.e., BSP's one-year ahead inflation forecasts along with the government inflation target) and lagged inflation affect private-sector inflation expectations in the Philippines. Similarly, Españo [2018] showed that the private sector considers the BSP's recent inflation forecasts in updating its own forecasts.

In 2019, the 6-month, 1-year, and 2-years ahead forecasts of the BSP, the private sector, and the IMF were all higher than the actual inflation outturn. However, the deviation of the forecasts from actual inflation was comparatively lower using the BSP's forecasts compared to the private sector and the IMF across the different forecast horizons.

In 2020, the 1-year and 2-year ahead forecasts of the BSP, private sector, and the IMF were also higher than the actual inflation outturn on account of the impact of the COVID-19 pandemic. Nonetheless, the forecast errors from the BSP are lower at -0.25 percentage point (ppt) for the 6-month ahead forecast, 0.29 ppt for the 1-year ahead forecast, and 0.46 ppt for the 2-year ahead forecast.

TABLE 9. Benchmarking with private sector and IMF

Year	Actual inflation	Deviation of forecasts from actual								
		6-month ahead			1-year ahead			2-year ahead		
		BSP	Private sector survey	IMF	BSP	Private sector survey	IMF	BSP	Private sector survey	IMF
2010	3.79	0.91	0.71	1.16	0.21	1.01	0.24	0.71	1.01	-0.29
2011	4.65	0.41	0.05	0.26	-1.03	-0.55	-0.65	-1.34	0.05	-0.15
2012	3.17	-0.07	-0.07	0.20	0.34	1.03	0.98	-0.15	0.93	0.83
2013	3.00	0.05	0.10	0.07	0.07	0.60	1.50	0.12	1.10	1.00
2014	4.10	0.07	0.20	0.33	0.38	-0.20	-0.56	-1.18	-0.20	-0.10
2015	1.43	0.65	0.90	0.63	1.57	2.17	2.44	1.81	2.17	2.14
2016	1.77	0.00	0.03	0.23	0.64	0.73	1.61	0.81	1.93	1.73
2017	3.20	-0.01	0.10	0.41	0.13	-0.20	0.25	0.04	-0.50	0.26
2018	5.20	-0.69	-0.70	-1.03	-1.80	-1.60	-2.19	-2.19	-2.10	-1.73
2019	2.47	0.22	0.43	1.36	0.71	1.63	1.52	0.75	1.03	0.53
2020	2.58	-0.25	-0.28	-0.86	0.29	0.32	-0.33	0.46	1.22	0.77
Average		**0.30**	**0.32**	**0.59**	**0.65**	**0.91**	**1.11**	**0.80**	**1.02**	**0.87**

Source: BSP estimates.
Note: Inflation data from 2010 to 2017 are derived from 2006-based CPI while the data from 2018 onwards are derived from 2012-based CPI.

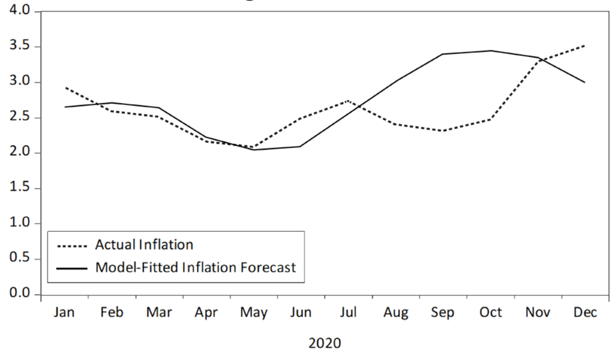
3.3. Counterfactuals for the COVID-19 episode

We find that the forecast errors computed after reflecting the actual values for all explanatory variables, such as GDP growth and oil prices, can be largely attributed to commodity prices that are not directly captured by the core models. The incorporation of add-ons for rice, other food items, electricity, and sin taxes to the purely model-generated forecasts lead to more accurate forecasts.[8]

[8] Given the limitations of macroeconomic models, "add-ons" are introduced to the baseline forecasts to reflect the expected impact of events that are not captured by the models. For example, the expected impact to inflation of tax reforms, such as the new sin taxes on alcohol and tobacco, are estimated outside the workhorse models based on the approved increases as well as timeline of implementation. The add-ons are also included as part of the forecast presentation to the TS, AC, and MB.

In the SEM/MEM, inflation is determined by oil prices, global non-oil prices, exchange rate, minimum wage, output gap, inflation persistence, and an error-correction term based on the quantity theory of money relationship. Factors estimated outside the model, which are added to the model-generated baseline forecasts, include adjustments for electricity rates, transportation fares, and prices of key food items such as rice, meat, fish, fruits, and vegetables.

FIGURE 12. Model-generated forecast using actual values of exogenous and endogenous variables



Source: BSP estimates.

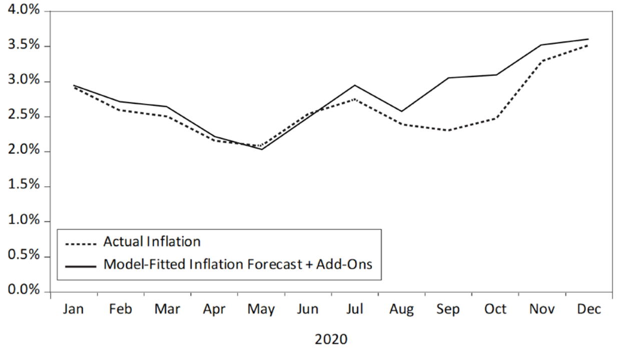
Figure 12 shows the model-generated inflation forecasts using actual values for all exogenous and endogenous variables in the MEM from January to December 2020. After incorporating the actual values for all explanatory variables of inflation, the model-fitted forecasts for 2020 had a MAE of 0.4 ppt. The model-generated inflation forecasts were relatively close to the actual inflation outturns in H1 2020. However, significant deviations were noted in June, August to October, and December 2020. These forecast errors can be attributed to shocks in commodity prices and services that are not directly captured by the model.

Inflation due to pricing policy changes and supply-side shocks are also the main drivers of the deviation of the inflation forecasts from actual numbers. For example, actual inflation outturns for June and July 2020 were higher by an average of 0.3 ppt compared to the model-predicted values because of actual fare adjustments to tricycles and jeepneys that were not considered in the original forecast. Meanwhile, actual inflation rates for August to October 2020 were lower by 0.9 ppt compared to the forecasts from the model due primarily to lower electricity rates following the refunds that Meralco implemented during those months. Finally, actual inflation for December 2020 was higher by 0.5 ppt compared to the model forecast due to the impact of the African Swine Fever (ASF) on pork prices.

The practice of supplementing the pure model results with estimated add-ons based on market surveillance improves the performance of the final forecasts.

Figure 13 shows the model-generated inflation forecasts plus the add-ons for rice, other food items, electricity, and sin taxes. The figure shows that the model-generated forecasts together with the add-ons were able to track the path and direction of inflation with improved forecast accuracy compared to the purely model-generated forecasts. The MAE of the model-generation forecasts with add-ons declined to 0.2 ppt.

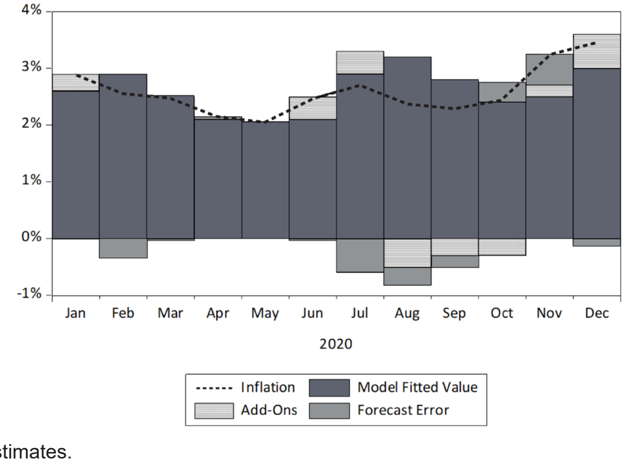
FIGURE 13. Model-generated forecast plus add-ons



Source: BSP estimates.

It should be noted that even after accounting for the add-ons along with the actual values of the explanatory variables, the forecasts still do not equate with actual inflation (Figure 14). The forecast errors at this point can be explained by several factors. First, several variables in the model, such as the output gap, are subject to measurement uncertainty given their unobservable nature. Second, the estimated coefficients of the model are also subject to parameter uncertainty especially with the significant structural break caused by the pandemic. Finally, errors can come from the specifications of the model given gaps in our understanding of the structure of the economy along with limits to economic theory.

FIGURE 14. Decomposition of inflation forecasts



Source: BSP estimates.

4. Communication of forecasts

Efforts to improve central banks' institutional credibility and transparency over the years have made monetary policy communications an essential part of the toolkit to influence inflation expectations and improve the effectiveness of the transmission of monetary policy [Batac et al. 2019]. The BSP communicates its inflation forecasts through several channels including the press conference after every policy meeting, publication in the highlights of the MB's meeting, the quarterly inflation report, and a month-ahead inflation forecast statement.

4.1. Press conference and highlights of the MB policy meeting

The MB meets eight times a year, spread out between six to eight weeks, to deliberate on the appropriate monetary policy stance. A press conference is held at 4 PM on the day of the policy meeting to discuss in detail the various factors underpinning the BSP's recent monetary policy decision. The BSP started live-streaming the entire press conference, including the Q&A portion, on Facebook starting in 2018. Previously, only the BSP Press Corps had live access to the press conference, while a recording of the Governor reading the press statement was uploaded on YouTube.

In addition, a press statement on the BSP's monetary policy stance is released. The statement presents the BSP's qualitative assessment of the inflation outlook, the balance of risks surrounding said outlook, along with the risk factors on the upside and downside to communicating the uncertainty surrounding the forecasts.

During the press conference, the Deputy Governor of the Monetary and Economics Sector provides the latest point forecasts of annual headline inflation over the policy horizon. Likewise, the DG discusses a list of factors that contributed to the revision in the forecast as well as the details of the inflation path.

The inflation forecasts are then published in the Highlights of the MB's policy meeting, which is released four weeks after the meeting. The inflation outlook section of the report shows a comparison of the latest and previous baseline inflation forecasts, the shape of the inflation forecast path, and the reasons for the revision in the inflation forecasts. Similar to the press statement, it will contain the overall assessment of the balance of risks and the list of risk factors considered.

4.2. Quarterly inflation report

In the quarterly BSP Inflation Report, the section on the inflation outlook provides the point inflation forecast and the fan chart over the policy horizon. It also discusses the major assumptions that underly the forecast on both the supply- and demand-side relative to the published path and forecast assumptions in the previous quarter. There is also a discussion on the different risks to inflation, how these are expected to affect the outlook, and their implications on the monetary policy decision of the BSP during the quarter.

Aside from inflation, there is also a descriptive discussion on the growth outlook and output gap that is consistent with the baseline inflation path. We provide the expected directional path of GDP in the current quarter as well as the trajectory of growth over the policy horizon as well the factors expected to drive output growth in the country.

4.3. Month-ahead inflation forecasts

Unlike other central banks, the BSP publishes an inflation forecast range for the current month on the last working day of the month, via the BSP's website and social media accounts. The practice of releasing a month-ahead inflation forecast started when the BSP shifted to inflation targeting in 2002. The goal of the monthly forecast range is to help anchor the public's inflation expectations especially during periods of significant price volatility.

More recently, the BSP started releasing a statement on its view of inflation over the medium term, posted on the BSP's social media accounts, right after the Philippine Statistics Authority publishes the official data on the monthly CPI. The statement aims to focus attention on the BSP's medium-term view on inflation away from short-run inflation developments.

5. Future work

The DER is continuously refining and improving its suite of models for forecasting, scenario-building, and policy analysis both internally and in collaboration with external consultants from the academe and multilateral agencies. The enhancements in the suite of models have allowed the BSP to better capture the interlinkages and emerging dynamics in the economic and financial system, and thus improve macroeconomic forecasting performance based on forecast error statistics. Nevertheless, the refinements in the modelling toolkit is an ongoing process, requiring experience and continuous training of the staff on the latest methodological developments in the field and the cooperation among central banks on the best practices in modelling and forecasting.

In 2019, the staff worked with Dr. Suleyman Ozmucur of the University of Pennsylvania on a project funded by the World Bank to develop mixed-frequency models for nowcasting inflation, GDP growth, domestic liquidity, exchange rate, and the current account. The models from the project are currently being used for short-term forecasting and analysis which are then factored in the BSP's workhorse models for medium-term forecasting.

The workhorse models are subject to periodic review and evaluation to incorporate new data as well as to reflect changes in data series or shifts in inflation dynamics. The staff is currently reviewing, re-specifying, and re-estimating the BSP SEM/MEM to capture the recent data points affected by the pandemic. The review also benefits from the feedback from the MB on DER's regular report on forecast evaluation. At the same time, new variables and equations will be added to expand the macroeconomic variables considered in the model. These include estimation of equations for core inflation, unemployment rate, and credit among others. The new versions of the models will be internally tested through parallel runs in 2022.

Moreover, continued enhancements on the BSP's Policy Analysis Model for the Philippines (PAMPH), through a series of consultation workshops with technical experts from the GPMN, is ongoing. The PAMPH is a monetary policy model for a small open economy. It is a New Keynesian semi-structural gap model for analyzing the monetary policy transmission mechanism of key macroeconomic variables over a medium-term horizon. It features an endogenous monetary policy with forward-looking model agents reacting to the expectations of future policy decisions [Alarcon et al. 2020]. Ongoing efforts to review and improve the PAMPH will enable the BSP to formalize its FPAS and shift to the semi-structural model as its workhorse model for monetary policy analysis.

The DER has also started consultations with experts from the Japan International Cooperation Agency (JICA) to collaborate on potential projects related to macroeconomic modelling and forecasting. By 2022, the project will proceed by developing a Trend Inflation Projection System (TIPS) for the Philippines. The model will be useful in setting the appropriate medium-term inflation target for the country. TIPS will allow the BSP to quantify long-run inflation dynamics by estimating the trend components of headline and core inflation. The model can also decompose inflation into its permanent and transitory components to better explain the drivers of supply-side shocks and how it influences price dynamics over the policy horizon. Finally, the TIPS will incorporate inflation expectations coming from the private sector together with adaptive inflation expectations in its analysis. This will enhance the understanding of the expectations channel of monetary policy, which is not fully incorporated in the BSP's current macroeconomic models.

The DER has also engaged with the IMF's Institute for Capacity Development (ICD) for a technical assistance on macroeconomic frameworks covering extensions of the standard Quarterly Projection Model (QPM) for the Philippines (Guo et al. [2019]; Karam et al. [2021]). The extended model presents a practical extension of a standard semi-structural model to incorporate the credit cycle and macroprudential blocks, thus providing an avenue to answer relevant questions including the monetary policy response to shocks in the financial system (e.g., shocks to credit demand and bank profitability), complemented with macroprudential policy. Highlighting such interaction between the monetary and macroprudential policies is of paramount importance to the BSP. An extended QPM can usefully help BSP's future refinements of the PAMPH to incorporate other features, such as credit aggregates and reserve requirements. Equally important, the TA will help strengthen DER's capacity to shift to the PAMPH as the BSP's workhorse model for monetary policy analysis and forecasting.

Big data-related initiatives are being pursued to enhance further the current inflation forecasting process. For instance, the consultants from University of the Philippines crafted a proof of concept on the price indices prototype using web-scraped data for the BSP Big Data project, which the Department of Economic Statistics is working to operationalize. Once developed, the price index could be utilized in the inflation nowcasting exercises of the DER.

The TS is also exploring potential areas for improvements in the FPAS, such as the forecast combination from different satellite nowcasting models and the adoption of governance and control protocols in the forecasting process as recommended by the Internal Audit Office (IAO) in its Year 2019 Review of the BSP's Inflation Forecasting Process. The Department is also working to improve labor market indicators used in monetary policy models to better capture the interaction between monetary policy and employment, along with further analysis and estimation of the non-accelerating inflation rate of unemployment (NAIRU) and employment gap to complement existing models on the natural interest rate and the output gap.

Looking ahead, the FPAS of the BSP will continue to evolve to support the formulation of data-driven and evidence-based policy decisions. At its core, the workhorse models will be regularly reviewed and enhanced as necessary (e.g., revisions in model structure, addition of new equations, recalibration of parameters, etc.) to reflect the very fluid nature of macroeconomic environment, adopt international best practices among central banks in macro economic forecasting and policy simulations, and take advantage of technology innovations. The satellite models will be similarly developed and improved to complement the workhorse models. Furthermore, the evolution of FPAS goes beyond the modelling aspect to cover institutional arrangement, reporting system, and risk assessment, among others.

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