Topical Research and Highlights

Assessment of the Size and Factors Behind the Inflation Forecast Error in the Post-Covid-19 Pandemic Period

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BULGARIAN NATIONAL BANK

Assessment of the Size and Factors Behind the Inflation Forecast Error in the Post-Covid-19 Pandemic Period

Central banks' primary objective is to maintain price stability. Therefore, inflation forecasts are essential for monetary policy transmission. The analysis of errors in the inflation forecast allows for the identification of the drivers behind the deviations of actual inflation from expected inflation, including limitations in the data used for the projection of economic developments, a misunderstanding of the state of the economy at the time of the preparation of the forecast and/or the occurrence of unforeseen events with a major economic impact. In addition, the analysis of systematic errors in inflation forecasts might be indicative of structural changes in the economy that call for adjustment of the forecasting macroeconomic models in use. The current highlight aims at presenting the BNB's inflation forecast errors in the post-December 2020 period and identifying the root causes thereof.

Chart 1 compares actual inflation and inflation projected by the BNB between December 2020 and March 2023, for which 10 macroeconomic forecasts have been produced. Over the review period, global inflation tended to accelerate rapidly, which was the reason behind larger forecast errors in most central bank forecasts, as well as a systematic underestimation of inflation, even in the short term. A similar problem is observed in ECB's inflation projections, which have been used as a reference for this highlight (see Chart 2). As regards the BNB macroeconomic forecasts, in the first two quarters of the projection horizon the forecast errors are relatively small and there are no indications of a systematic one-side deviation of actual inflation from projected inflation. However, some underestimation of inflation has been observed in the period following the third quarter of the projection horizon[1]. The analysis

Chart 1. Comparison of Actual Inflation and Annual Inflation for Bulgaria Projected by the BNB
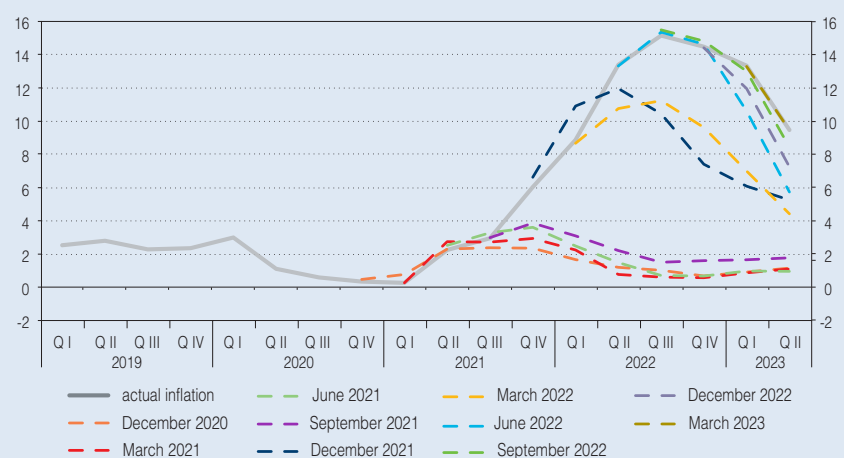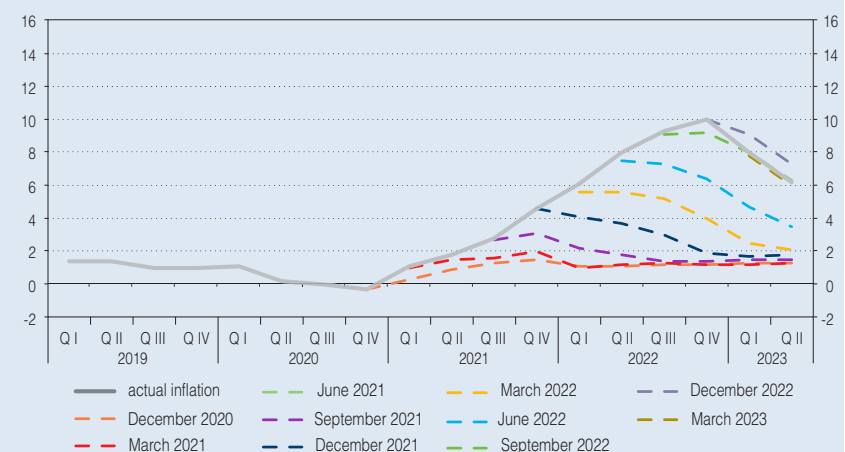
(per cent)

Note: Actual inflation for the second quarter of 2023 refers to the April–May 2023 period.
Source: BNB.

Chart 2. Comparison of Actual Inflation and Annual Inflation for the Euro Area Projected by the BNB

(per cent)

Sources: ECB, BNB.

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[1] However, the forecast error (measured by root-mean-square forecast error formula) is lower than that of the ECB, especially in the period after the end of 2021 when the ECB had consistently projected a slowdown in euro area inflation from the first forecast quarter.
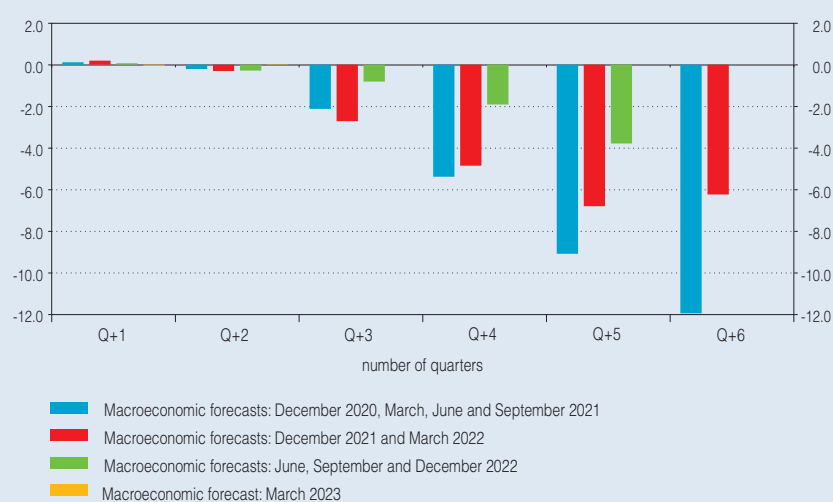
of the BNB forecast error aims to determine the extent to which this underestimation of inflation reflects the rapidly changing economic environment both globally and in Bulgaria following the COVID-19 pandemic, which is a prerequisite for reducing the information content of technical assumptions of the forecast about international price developments, as well as the extent to which the error results from possible limitations in the macroeconomic model and/or the estimates of the forecasters.

As regards the size and the reasons behind the inflation forecast errors, macroeconomic projections produced after December 2020 can be broken down into four groups (see Chart 3)[2]. The first group comprises four projections prepared in the period of economic recovery from COVID-19 (from December 2020 to September 2021). The second group includes two projections (from December 2021 and March 2022), prepared immediately before and after the outbreak of the war in Ukraine and characterised by exceptionally high uncertainty and volatility in commodity prices on international markets. The third group of projections covers the period from the second half of 2022, when market participants had already adapted their views on the economic effects of the war in Ukraine, as reflected in their assumptions about international price developments. The fourth group covers the March 2023 forecast, for which there is not yet sufficient reporting data to calculate the forecast error over a longer horizon and compare it with the other forecasts.

Chart 3 shows that as the projection horizon progresses, the most significant error is observed in the first group's forecasts. Some underestimation of inflation has begun since the fourth quarter of 2021, mainly due to the strong rises in natural gas and electricity prices in Europe over this period. When producing the forecasts of the first group, price rises in these commodities and the inter-relationship between their prices[3] were not reflected in market participants' expectations (technical assumptions of the forecast), nor were these commodities included in the structure of the BNB's macroeconomic model.[4] The integration of Bulgaria's electricity system with that of Romania and Greece in 2021[5] represents a structural

Chart 3. Inflation Forecast Error by Quarter (Average of Individual Forecasts)

(percentage points)

- Macroeconomic forecasts: December 2020, March, June and September 2021
- Macroeconomic forecasts: December 2021 and March 2022
- Macroeconomic forecasts: June, September and December 2022
- Macroeconomic forecast: March 2023

Note: The forecast error is calculated as a deviation of projected inflation from actual inflation. Positive/negative values correspond to overestimation/underestimation of inflation.

Source: BNB.

[2] In comparing individual forecasts and calculating forecast errors, the analysis employs data up to the second quarter of 2023. As at the time of producing the highlight, HICP data for the second quarter of 2023 are only available for April and May, it is assumed that annual inflation for this quarter corresponds to the average annual inflation rate for these two months.

[3] In some EU Member States, a portion of natural gas is used for electricity generation, which led to a simultaneous price increase in both energy sources at the end of 2021 and the first half of 2022.

[4] In the period before 2021, electricity and gas prices in Bulgaria were characterised by a low volatility, as electricity consumption in Bulgaria was fully provided by domestic electricity generation, and Bulgaria's electricity system was not integrated with that of other EU Member States and gas supplies were based on concluded long-term contracts. This meant that the prices of these commodities had no significant effect on the changes in firms' production costs in the period prior to 2021. Hence, of all energy prices at that time, only the price of Brent crude oil was used in the BNB's macroeconomic model.

[5] In 2021 the Independent Bulgarian Energy Exchange (IBEX) was fully integrated in the Day Ahead electricity market in South-East Europe, which was implemented in two steps. In May 2021, the integration of the Bulgarian–Greek bidding zone border was completed, while in October 2021, the coupling with Romania was accomplished. For details, see the IBEX press release, in Bulgarian only.

change for the economy, which is the reason for the market price of electricity for domestic business consumers to begin to be determined mainly by external factors.

In preparing the macroeconomic projections of December 2021 and March 2022 (the second group of forecasts), changes were made to the macroeconomic model to reflect the effects of changes in international electricity and gas prices on the production costs of firms in Bulgaria and their pass-through to individual HICP components, such as food, services and central gas supply. As illustrated in Chart 3, these projections suggest a smaller forecast error, though it remains relatively large as the projection horizon advances. This can be attributed to the onset of the war in Ukraine and the fact that technical assumptions in the second group's projections do not fully reflect economic effects of the war on commodity prices (energy and non-energy), the existing bottlenecks in regional supply chains and the heightened economic uncertainty, which may have influenced firms' pricing policies. Moreover, the rise in inflation expectations in combination with the tight labour market conditions in Bulgaria leads to a marked increase in the two-way link between prices and wages in the economy *vis-à-vis* the forecasts in the second group (based on the historical relationship between the two variables) in the first half of 2022, which is a precondition for an underestimation of core inflation over the medium term.

Chart 4 shows a decomposition of the error in the inflation forecast by component of the Harmonised Index of Consumer Prices (HICP), with the four panels presenting the previously defined four time groups of projections prepared by the BNB. In the December 2021 and March 2022 projections, most of the forecast error relates to energy products inflation (excluding administratively controlled prices) and food, for the forecast of which technical assumptions for international prices are of major importance (see Chart 4b). Administratively controlled prices are another group with underestimated medium-term inflation. This is largely due to the approach applied until the end of 2021 to include in the macroeconomic forecast only regulated price increases announced by the relevant regulators and to leave these prices unchanged for the remaining part of the forecast horizon. The reason for applying this approach is that prices of goods and services with administratively controlled prices are not based on market supply and demand, and consequently the regulators do not always adjust them to their production costs. Taking into account the underestimated headline inflation, particularly in periods of strongly upward dynamics in international prices of major energy sources, the approach used in forecasting administratively controlled prices was partly changed at the end of 2021. With this change, in the medium term, the projected prices of regulated goods and services reflect wage growth in the economy, causing a permanent change to firms' production costs which should be taken into account by regulators when setting the prices of administratively controlled goods and services.

The June 2022 macroeconomic forecast and, in particular those of September and December 2022, show a significant reduction of the inflation forecast error. The only HICP component, for which inflation is still somewhat underestimated as the projection horizon advances, is the food group. This stems from downward developments in food and energy commodity prices in international markets in late 2022 and early 2023, which were included in the technical assumptions of the projections and according to the estimated historical macroeconomic relationships imply a relatively rapid pass-through to end-use consumer prices of food in Bulgaria (within six quarters). Concurrently, data reported for the end of 2022 and the first five months of 2023 showed a continued steady increase in end-use consumer prices of food despite their depreciation in the previous stages of the supply chain (mainly at agricultural level[6]). The accumulated high stock of raw materials in the economy is likely to contribute to these developments, which results in a slower pass-through of the current decline in international prices on firms' production costs. Another factor behind divergent developments observed between prices at the beginning and at the end of the

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[6] The European Commission data on agricultural producer prices by country are used. For details, see: https://agridata.ec.europa.eu/extensions/DataPortal/prices.html.

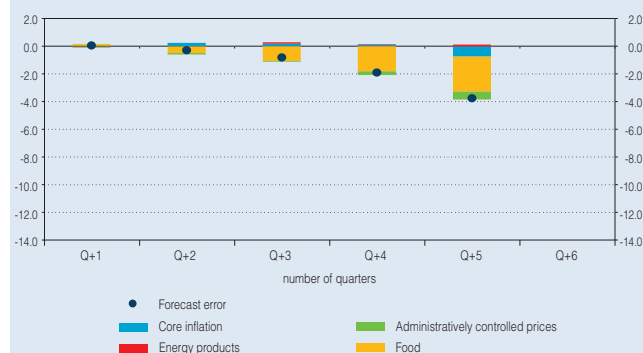## Chart 4 Inflation Forecast Error by HICP Group (Average of Individual Forecasts)

4 a) December 2020 to September 2021 forecasts
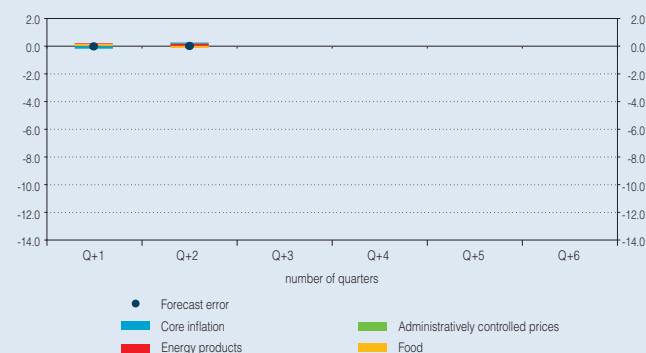(per cent, percentage points)
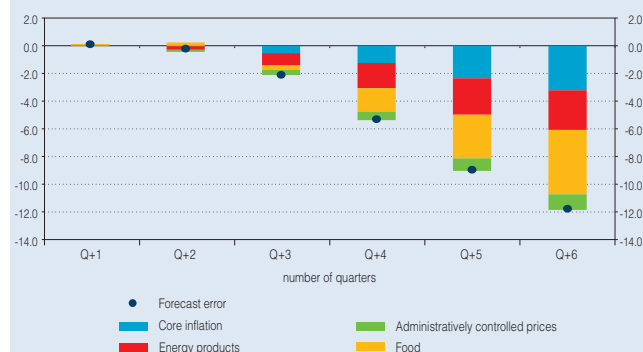
4 b) December 2021 and March 2022 forecasts
(per cent, percentage points)
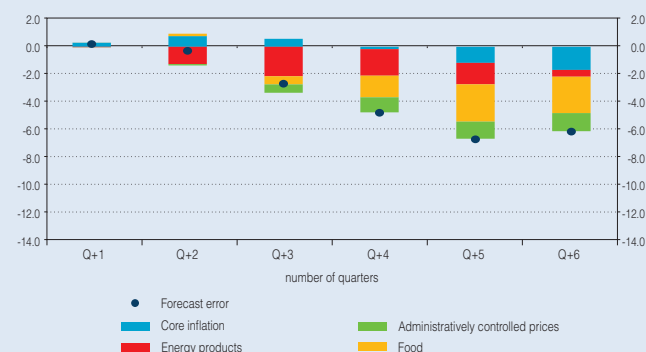
4 c) June 2022 to December 2022 forecasts
(per cent, percentage points)

4 d) March 2023 forecast
(per cent, percentage points)

Note: The forecast error is calculated as a deviation of projected inflation from actual inflation. Positive/negative values correspond to overestimation/underestimation of inflation.
Sources: ECB, BNB.

supply chain may be an asymmetric response by firms to falling commodity prices, which can be determined by the adjustment of pricing policies to Bulgaria's specific macroeconomic conditions (*e.g.* firms are reluctant to lower end-use product prices or even increase them in response to strong consumer demand, despite the lower commodity prices used to produce them). Such dependence on the price behaviour of firms on specific macroeconomic conditions was identified in research for Bulgaria at micro level carried out by the BNB[7] and was reflected to some extent in the macroeconomic projections prepared in the second half of 2022 (see Chart 5). This is one of the reasons for the smaller forecast error in the food group.
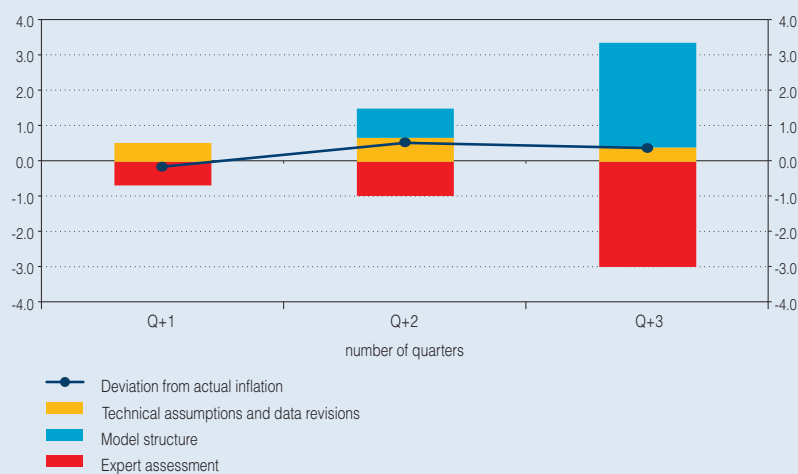
In conclusion, the BNB inflation forecasts in the post-December 2020 period have been characterised by a small non-systemic error in the short term. After the third quarter of the projection horizon the forecast shows a trend toward underestimation of inflation, mainly owing to the occurrence of unforeseen events with a strong economic effect over the review period and the need to revise the technical assumptions on external environment developments in the forecast. Changes to the BNB macroeconomic model, starting to model the electricity and gas price dynamics on international markets as an additional component of firms' costs of production, contribute to the improvement of the headline inflation forecast. The BNB approach to forecasting administratively controlled prices is another factor behind the increasing forecast error as the forecast horizon advances, with the change in the approach to forecasting inflation in this group helping to somewhat decrease

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[7] For details, see: Kasabov, D., Paskaleva, P. (2018) "Cost- and Price-setting Drivers in Bulgaria in the Period 2009–2013, WDN Survey Evidence", Bulgarian National Bank DP/112/2018**.**

the forecast errors. The weak and slow pass-through of downward developments in international prices to end-use consumer prices is another potential factor for building up a forecast error as the projection horizon advances. This is one of the reasons why the fan chart of inflation in the current macroeconomic forecast continues to exhibit a broader-than-usual range of uncertainty prior to the COVID-19 pandemic and risks to the forecast to be assessed as broadly shifted to higher inflation.

Chart 5. Decomposition of the Factors Behind the Size of the Inflation Error in the September and December 2022 Forecasts (Average of Individual Forecasts)

(percentage points)

- ● Deviation from actual inflation
- ▬ Technical assumptions and data revisions
- ▬ Model structure
- ▬ Expert assessment

Notes: Positive values mean that the relevant factor has contributed to the widening of the difference between actual and projected inflation.
The chart shows a decomposition of the forecast error for the September and December 2022 projections only, as the technical assumptions explaining the forecast error in these projections played a significantly smaller role than in previous projections.
Source: BNB.