Box 3.1

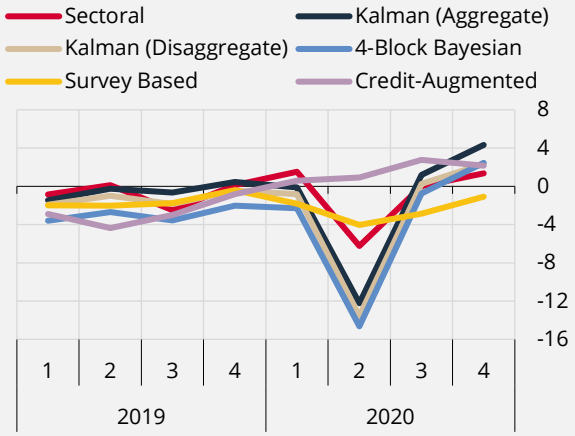
A Technical Assessment of Output Gap Estimates

Output gap indicators, showing the cyclical pattern of the economy, are used to monitor demand and capacity pressures on inflation. The output gap is defined as the difference between the level of economic activity and its non-inflationary potential level. The inflationary state of the total supply-aggregate demand balance during periods of overheating is referred to as a "positive" output gap. The contraction/cooling phases of business cycles are represented by the situations where the output gap is below zero and has a disinflationary effect.

The output gap has an important place in the "forecasting and policy analysis system" (FPAS), which is at the center of the technical background of the inflation-targeting regime. In this box, we compare the inflation forecasting power of output gap indicators monitored by the CBRT. In the light of growth and inflation developments in 2020, evaluations and policy implications are outlined regarding the relative advantages of these indicators.

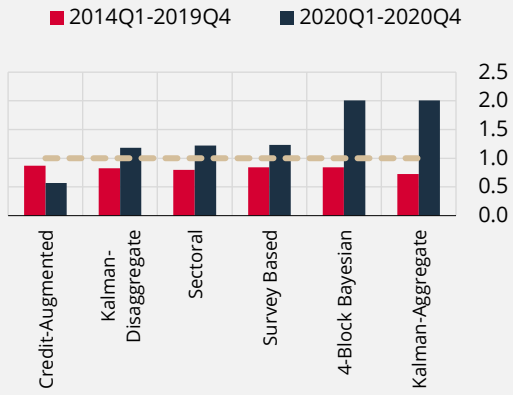
Output gap indicators estimated with different models and approaches are presented in Chart 1. Among these, the "survey-based" indicator is constructed by aggregating variables such as the capacity utilization rate and the airplane occupancy rate that directly point to the output gap by definition. Other indicators are estimated by filtering economic activity indicators. The credit-augmented indicator is calculated as the weighted average of the output gap based on the filtering of national income and the deviation of net credit use from its historical average.

Chart 1: Output Gap Indicators[1] (%)



Source: CBRT.

Chart 2: Forecasting Performance of Models Using Different Output Gap Indicators[2] (Forecast Errors Compared to the Model Excluding Output Gap)*



Source: Authors' calculations.
* Forecast errors are calculated separately for 2014Q1-2019Q4 and 2020Q1-2020Q4. The forecast error of the model excluding output gap is indexed as 1.

[1] Studies on the methods of output gap series included in the chart are as follows: Sectoral: Çelgin and Yılmaz (2019), Kalman(Aggregate): Koca (2021), Kalman(Disaggregate): Alp, Öğünç and Sarıkaya (2012), Koca and Kalafatcılar (2021), 4-Block Bayesian: Gökcü, M. (2021), Survey Based: Coşar, Kösem and Sarıkaya (2012), Coşar, Kösem and Sarıkaya (2013), Coşar (2018) and Credit-Augmented: October 2020 Inflation Report Box 2.3.

[2] The quarterly change in the Core-B index (adjusted for tax effects) is used as the dependent variable. The exchange rate (the euro and dollar basket) and commodity prices excluding energy are used as explanatory variables. Forecast performances are compared by adding different output gap indicators separately to the base model constructed with these explanatory variables. Forecasts are made for the period 2014Q1-2020Q4 with the out-of-sample forecast performance method for the next quarter. For example, the 2020Q2 forecast has been obtained by multiplying the coefficients obtained from the model regressed up to 2020Q1 with the 2020Q2 data of the explanatory variables. Then, the 2020Q3 forecast has been obtained with the coefficients obtained from a regression made until 2020Q2 and 2020Q3 values of the explanatory variables. A dummy variable for 2018Q3 is used in the models. The analysis of forecast errors is done excluding 2018Q3. In the chart, the root mean squared errors of forecasts are presented by normalizing this value for the model excluding the output gap.

Although the indicators seem to be compatible with each other in general, they can give quite different signals for the same quarter. During the pandemic period, when supply and demand shocks were seen together, the apparent divergence between indicators, especially in the second quarter of 2020, led to increased uncertainty regarding inflation forecasts. In this period, the sharp contraction in the economic activity caused a decline in national income-based output gap indicators, while the credit-augmented output gap started to show signs of heating due to the rapid credit expansion. With the significant recovery in the economy in the second half of the year, the agreement between indicators has increased. Most of the indicators for the last quarter signal overheating.

Such a large divergence among the indicators raises the question of which output gap indicator stands out in explaining inflation. In this context, we evaluated the one-quarter-ahead forecast performance of output gap indicators for the Core-B index. The results show that models using output gap in the 2014-2019 period made nearly 20% less mistakes than the model that did not use output gap (Chart 2). Due to their lagged effects on inflation, the forecast performance of the models using output gap indicators increases, as the forecast horizon gets longer.

Analyses made for the pre-2020 period indicate that none of the indicators is systematically superior in forecasting inflation. However, for 2020, using an output gap indicator in the forecasting model does not lead to an improvement in inflation forecasts, except for the model that uses the credit-augmented output gap indicator. When the credit-augmented output gap is used, an approximately 40% lower forecast error is made for 2020 compared to the base model that does not incude the output gap. Factors such as supply shocks that have an important role in the decline of national income in the second quarter, the rapid credit expansion supporting consumption despite increasing unemployment, and the marked divergence in sectoral demand conditions all made it difficult to measure the output gap and its impact on inflation.

Past studies of the Turkish economy point out that (i) credit developments can provide additional information when used in conjunction with the output gap to predict inflation, (ii) items affected by credits are mostly in the core goods group, (iii) the effect of credits on inflation is more lagged compared to the output gap and (iv) as a credit indicator, the net credit use stands out as a functional indicator (Özmen and Sarıkaya 2014, Öğünç and Sarıkaya 2015, CBRT 2020). Credit data are published in a timely manner and hence become available earlier than GDP and unlike filter-based gaps net credit use is not revised with the data flow. These two factors can be considered as additional advantages of using credit data. Developments in 2020 have shown that the inflation forecasting performance can improve signific antly if the financial cycle is also taken into account while evaluating the total supply-aggregate demand balance (output gap). However, since the inclusion of credits does not provide a systematic advantage valid for all periods, expert judgements are important in deciding when to give more weight to a certain indicator. When other determinants of inflation are also considered, aggregate demand conditions, which were stronger than previous projections in the second half of 2020, signal overheating in the economy, and a significant upward revision is made in the output gap estimates.

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