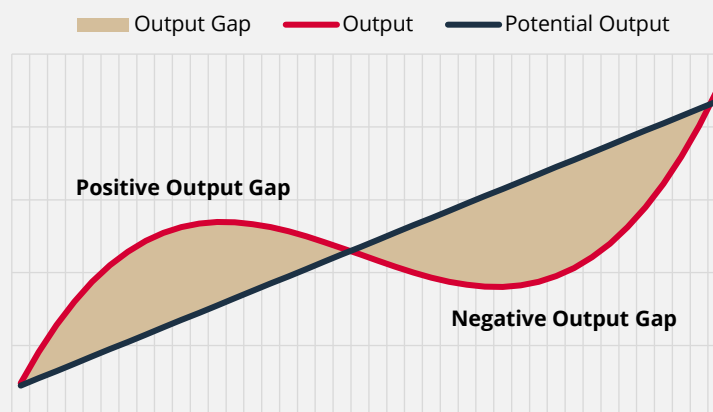


Box 3.1

Output Gap

Accurate measurement and timely monitoring of demand-side developments in the economy are of critical importance for central banks implementing inflation targeting regime from the monetary policy perspective. In this context, central banks closely monitor the output gap series¹, defined as the percentage point difference $((y-y^p)/y^p \times 100)$ of the current output level (y) relative to the potential output level (y^p) (Chart 1). Within the framework of monetary policy, potential output corresponds to the highest level of production that can be achieved without leading to an increase in inflation by using labor and capital factors efficiently, given the level of technology, and refers to the level of production that will not generate additional inflationary pressure. When the level of production is lower (higher) than its potential, in other words, when the output gap is negative (positive), it indicates that demand conditions may have a disinflationary (inflationary) effect. On the other hand, when the potential output level is taken as given, the change in the level of the output gap also provides information on the level of growth relative to potential. For instance, a decrease in the output gap indicates that growth will be below the potential growth rate corresponding to that period, while an increase in the output gap indicates that growth will be above potential. The output gap is also frequently used in the business cycle literature to distinguish between boom/overheating periods when output surpasses its potential and bust periods when output moves below its potential.

Chart 1: Potential Output and Output Gap



Output Gap Indicators Monitored by the CBRT

Since potential production or output gap figures in the economy are variables that cannot be observed directly, they are estimated with alternative methods in practice. In this respect, historical levels of the aforementioned variables can be constructed by estimation approaches such as production function and structural models, as well as by computation using various statistical filtering methods. On the other hand, survey indicators, which, by definition, directly indicate the course of demand conditions compared to their potential, such as the capacity utilization rate, are also used.

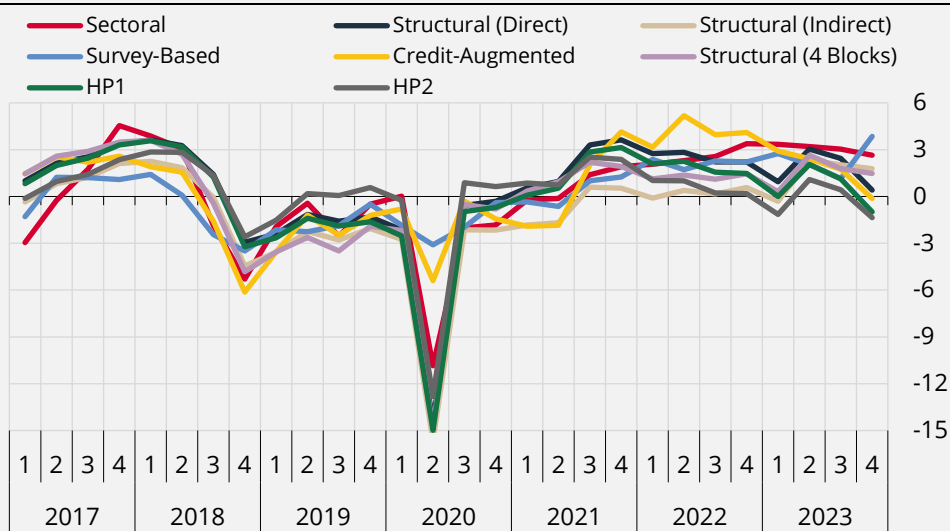
The indicators constructed by the CBRT to estimate the historical level of the output gap can be classified under three headings. The first group is based on statistical methods. There are four indicators within this group. The first two indicators are obtained by passing the GDP series through the Hodrick Prescott (HP) filter with two different smoothing parameters. The other indicator within this group is derived by enriching the output gap series obtained from the HP filter with the net credit use, employing coefficients from econometric models.

¹ The definition of output gap is sometimes confused with the difference of the growth rate between two periods from the potential growth rate, i.e. $(\Delta y/y)/(\Delta y^p/y^p)$. As explained here, the output gap is defined as the percentage point difference $((y-y^p)/y^p \times 100)$ between the current level of output (y) and its potential level (y^p).

The last indicator in this group is obtained by filtering out industrial production index subgroups by HP and aggregating them with the weights of their corresponding inflation series.² There is a single indicator in the second group. This indicator is based on the combination of survey data and leading indicator series that have an inherent output gap characteristic. In this indicator, in addition to survey data such as capacity utilization rate and backlog, series such as office occupancy rate and aircraft occupancy rate are used.³ In the third group, there are series acquired from general equilibrium models. These models are in a New Keynesian setup and use basic equations such as the Phillips equation, Taylor's rule and dynamic IS. Models differ from each other with regard to features such as whether they have a labor block, use calibration or Bayesian estimation for parameter selection, directly estimate the output gap or aggregate components like domestic demand gap and export gap.⁴ Since the output gap is an unobservable variable, the approaches discussed here are likely to have their own uncertainty ranges.

The indicators briefly introduced above vary in terms of properties such as end-sample bias, being affected by data revisions, economic consistency, and may give different signals from time to time. In this respect, the historical output gap measure is obtained from eight separate indicators. As well as the level of this measure, the extent to which the underlying series co-move with each other is of great importance in analyzing demand conditions. For instance, it is noteworthy that the divergence between the series has increased recently (Chart 2). This suggests that uncertainty regarding the level of the output gap has risen.

Chart 2: CBRT Output Gap Indicators



Indicators used to construct historical levels of the output gap measure are computed to include the quarter following the release of the latest GDP data, therefore nowcasts, and occasionally, the forecasts of the GDP for the next quarter are used. While the method based on surveys and leading indicators employ publicly available series, other series are created using the assumption set for short-term forecasts. Extending the output gap indicator for a period when there is no growth data plays an important role in providing up-to-date information on demand conditions as well as in constituting a starting point for medium-term forecasts. It should be emphasized that there is uncertainty over the value of the output gap, which is an unobservable variable, in the current quarter and in previous quarters.

The Role of the Output Gap in Forecasting and Policy Analysis System

In the previous section, the methods used to construct the historical values of the output gap were discussed, and it was emphasized that there is uncertainty over its historical values. This section will focus on the role of the output gap in the CBRT's medium-term forecasting and policy analysis system,

² For details, see Çelgin and Yılmaz (2019) and CBRT (2020).

³ See Coşar Erdoğan (2018).

⁴ For further details, see Gökçü (2021) and CBRT (2018).

and how it is used in practice. The CBRT constructs its medium-term forecasts using a forecasting and policy analysis system that includes semi-structural general equilibrium models. In this section, a simplified explanation of what the output gap means in terms of such models will be presented, followed by a brief discussion of the fact that the output gap, which can be explained relatively easily in the theoretical framework, is an ambiguous concept in practice.

Monetary policy is among the policies implemented to mitigate the adverse effects of business and financial cycles. When structural models are used to analyze the impact of monetary policy, many variables in the model, such as the real exchange rate and the level of output, are defined by the concept of “gap”, which indicates the percentage point deviation of the level from its trend or potential, and provides more information about where the economy is in terms of business and financial cycles. In this respect, the level of output enters the model as the output gap, and the projections from the models are obtained as the output gap. In other words, the forecast result of these models is the output gap, and no direct forecast of economic growth is obtained from such models. In such structural models, the output gap indicates whether aggregate demand conditions in the economy exert pressure on inflation. In this respect, households' consumption, saving and portfolio preferences are among the determinants of aggregate demand. Other economic agents also form other components of aggregate demand according to their expectations for variables such as exchange rates, interest rates and inflation, and thus the output gap is determined by the level of aggregate demand compared to potential output. The output gap in turn affects wages, exchange rates, interest rates and inflation through the labor market, foreign trade, financial decisions and price-setting behavior.

To simplify⁵ the role of the output gap in monetary transmission, we focus on how households make their consumption, saving and portfolio choices. In choosing between consumption and saving, households compare the utility they can gain by consuming now with the risk- and time-adjusted utility of the goods and services they can buy in the future by saving. Households are inclined to save more rather than consume now if the real return from saving is high enough, and the risk of waiting is low enough. In portfolio choice, economic agents will choose TL-denominated financial instruments if they believe that the risk and real return of TL-denominated instruments are more favorable than that of FX-denominated instruments. Through the transmission mechanism, monetary policy affects these two decisions by changing expectations and the returns on TL-denominated assets. Household's portfolio preferences combine with the portfolio preferences of other economic agents, including non-residents, to influence exchange rates. Exchange rates, in turn, affect economic activity and inflation through foreign trade, exchange rate pass-through and expectations.

In addition to aggregate demand, the level of potential output also determines the level of the output gap. In the case of households, savings have a significant impact on the potential output level. In simplified terms⁶, savings are used to finance investment. Therefore, if savings decrease, investment will decrease, and the level of production that meets demand will not be reached. If households, who make decisions based on interest rates, exchange rates, inflation and expectations about the future course of these variables, choose (excessive) consumption, savings will decline and potential production will be hampered as investment expenditures necessary to sustain production will not be made. In this case, excessive consumption will heat up the economy, adversely affecting the trade balance and putting upward pressure on wages and inflation. This excessive level of demand implies a positive output gap and increases inflation. On the other hand, when there is direct capital investment, a decline in commodity prices, quantitative increases in factors of production or high productivity gains, the potential output level of the economy increases, albeit temporarily, thereby increasing the amount of demand that can be met without causing inflation. In that case, if the level of non-inflationary output

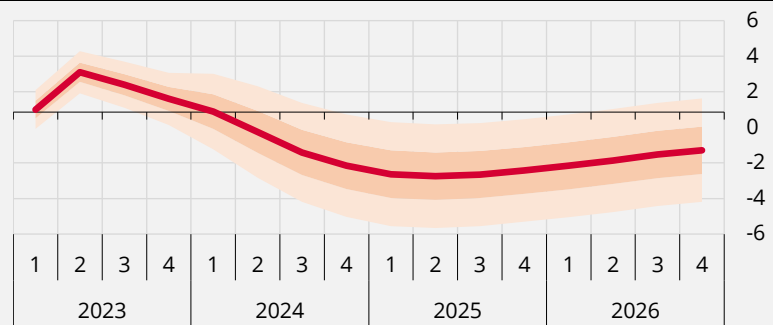
⁵ In this section, the function of the output gap in structural models will be explained within the framework of the demand channel and simplified exchange rate channel, which are the main channels of the monetary transmission mechanism, based only on the basic decisions of households. The interaction between the output gap and other macroeconomic variables in structural models is much more complex than the one described here, with a multi-faceted general equilibrium concept that affects each other simultaneously. However, for pedagogical reasons, some basic channels are selected and simplified here.

⁶ Simply put, in a closed economy, there is a one-to-one relationship between investment and savings. In other words, savings are the only source of investment and one of the main drivers of future growth. In an open economy, on the other hand, the difference between investment and savings can be covered by the foreign trade deficit. Therefore, household savings remain important for the sustainability of foreign trade balance and investment.

increases while the level of demand remains constant, the output gap (under the simplifying assumption that its previous value is 0) becomes negative.

Since concepts such as excess demand or the non-inflationary (potential) level of output, which are relatively easy to explain theoretically, cannot be observed in real life, uncertainties arise about both the sign and the magnitude of the output gap. Moreover, there may be discrepancies between the long-run values of the non-inflationary growth rate and its short- and medium-term values. In the long run, the potential growth rate depends on structural factors such as demographics, average productivity growth and the rate of increase in production resources, while in the short and medium term, it may depend on highly volatile cyclical productivity growth, capital flows and domestic currency denominated commodity and import prices, especially in emerging economies. In a period when capital flows are relatively high, commodity prices are moderate and productivity growth is strong, disinflation can be achieved with relatively high growth. This is because in such periods, the level of non-inflationary (potential) output may (temporarily) increase, and hence the output gap may turn negative and/or remain at negative levels. This suggests that, especially in emerging economies, the growth implied by the output gap may vary, and the inflation-growth trade-off of monetary policy may also vary over time.

Chart 3: Output Gap Estimates Uncertainty Band*



Source: CBRT, TURKSTAT.

* The probability that the output gap is within the uncertainty band is 30% for the dark shaded area and 60% for the light shaded area.

In fact, the models used by the CBRT in forecasting and policy analysis point to a wide range of uncertainty in historical data and future projections on both the non-inflationary (potential) output level and the output gap. To clarify the concepts explained in this box, Chart 3 presents an uncertainty band corresponding to the 60% significance level for output gap forecasts in the Medium-Term Projections section of the Inflation Report. When the uncertainty about the potential output level itself is added to the width of the forecast range around the output gap, the range of uncertainty about the level of growth implied by the output gap becomes so wide that its informative value decreases. Therefore, the forecasts in the Inflation Report are communicated with a baseline output gap level that symbolizes the intended/anticipated stabilizing effect of monetary policy on demand, and the high uncertainty in the output gap or the non-inflationary (potential) output level is not communicated. The output gap communication aims to express how the central bank intends to affect demand in light of monetary policy decisions and other expected economic developments. An output gap that shifts from positive to negative levels in the future should be interpreted as a sign that the central bank will stabilize demand through monetary policy, encourage households to save, and thus, achieve sustainable growth rates in the future. Central banks analyze whether the demand conditions implied by the output gap have been reached with each new data release and make monetary policy decisions in order to reach the inflation forecast path. As important as the level and change in the output gap is the evolution of private consumption and saving indicators and expectations in line with monetary policy objectives. In this respect, these indicators are closely monitored. Obviously, various unforeseen shocks that are outside the monetary policy domain may shape prices and demand unexpectedly. In that case, it is the central banks' duty to establish an accurate and effective communication and policy strategy, considering the lagged and cumulative effects of monetary policy.