Box 3.1

An Evaluation of the Impact of Output Gap on Inflation

The relationship between aggregate demand conditions and inflation is often studied by using Phillips curve models in the literature. In such equations, the outlook for demand conditions is measured by the output gap and the magnitude of the effects of the output gap on inflation is estimated. Although the general consumer price index is used in these calculations, the effect of demand conditions on inflation may vary across the sub-groups of consumer prices. For instance, Atuk et al. (2014) showed that a significant portion of inflation does not react significantly to the output gap. Similarly, Özmen and Sarıkaya (2014) found that prices of services are more commonly affected by the output gap than core goods.

In addition, there are many studies in the literature on whether the Phillips curve is linear or whether the effect of the output gap on inflation is asymmetric. For example, it can be argued that during periods of stagnation, when the output gap is too deep, the decline in inflation may be more limited than implied by linear models, or that there is no significant impact on inflation unless the output gap decreases to sufficiently negative levels. In this box, considering its role in the decline of inflation, the output gap-inflation relationship in Turkey is analyzed both to include non-linear effects and in terms of core goods and services separately.

As a benchmark, reduced-form Phillips curve models in Koca and Yılmaz (2018) are constructed for core goods and services equations. The Phillips curve models are extended by the addition of the square of the output gap, which will test the presence of nonlinear effects. Models are estimated for the period between 2006Q4-2019Q3. Estimated equations for core goods and services are given below:

$$\pi_t^{CG} = \alpha_{0,t} + \sum_{i=1}^{3} \alpha_{i,t} \Delta e_{t-i+1}^{USD/TRY} + \alpha_{4,t} \Delta \mathrm{p}_t^m + \alpha_{5,t} \widetilde{y}_t + \alpha_{6,t} (\widetilde{y}_t)^2 + \tau_t + \varepsilon_t \qquad (1)$$

$$\pi_t^S = \beta_{0,t} + \beta_{1,t} \Delta food_{t-1} + \beta_{2,t} \Delta e_t^{BASKET/TRY} + \beta_{3,t} \Delta w_{t-1} + \beta_{4,t} \pi_{t-1} + \beta_{5,t} \widetilde{y}_t + \beta_{6,t} (\widetilde{y}_t)^2 + \epsilon_t \qquad (2)$$

where π_t^{CG} is seasonally adjusted core goods inflation and π_t^S is seasonally adjusted services inflation excluding communication services; π_t is seasonally adjusted headline inflation; $e_t^{BASKET/TRY}$ and $e_t^{USD/TRY}$ are the quarterly average of Basket/TRY (USD/TRY and EUR/TRY average) and USD/TRY exchange rate, respectively; $\widetilde{y}_t$ is the two-quarter moving average of the output gap; $\Delta food_t$ is seasonally adjusted food inflation excluding fresh fruits and vegetables; w_t is the four-quarter moving average of real unit labor cost; p_t^m is the quarterly average of import prices, and finally, τ_t is the contribution of tax adjustments to core goods inflation. Δ stands for the logarithmic difference.

The output gap contribution to inflation is calculated by using output gap coefficients from model estimations and the level of the output gap, and thus information on the relationship between economic activity and inflation is obtained.[1] The nature of the relationship and the factors that determine this relationship will contribute to a better understanding of the support that aggregate demand conditions can provide to the disinflationary process. In this context, Table 1 presents the coefficients and significance levels of the output gap variable.

[1] Findings that the relationship between inflation and the output gap is not linear were also confirmed by the results obtained by the Markov Switching method.

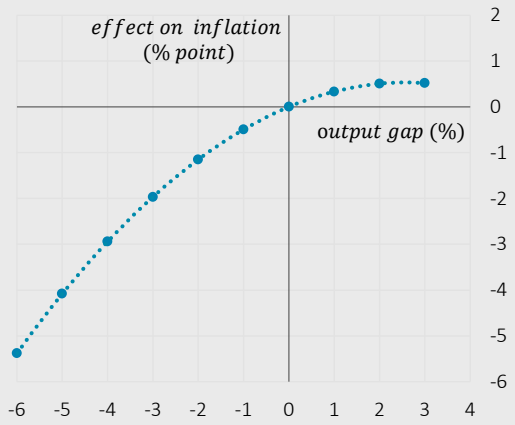
Table 1: Estimation Results

Dependent Variable:	*Core Goods*	*Services*
$\widetilde{y}_t$	0.104*	0.108**
$\widetilde{y}_t^{\,2}$	-0.020**	0.005*

* and ** represent statistical significance at the 10% and 5% level, respectively.

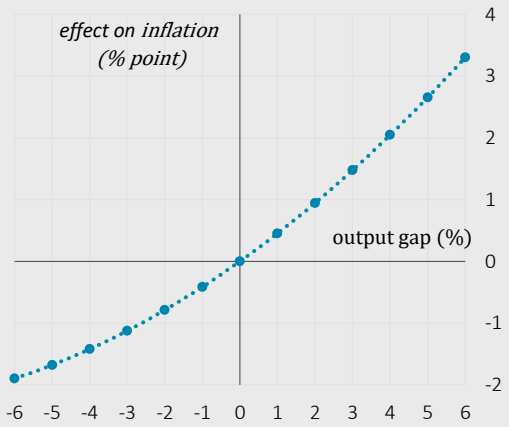
Chart 1 and 2 show the contribution of the output gap to annual inflation with the coefficients obtained from core goods and services equations and the change of this contribution across different levels of the output gap.

Chart 1: Effect of the Output Gap on Core Goods Inflation



Source: Authors' calculations.
Note: The horizontal axis shows the level of the output gap and the vertical axis shows the effect of the output gap on inflation.

Chart 2: Effect of the Output Gap on Services Inflation*



Source: Authors' calculations
(*) Services inflation excluding communication services.
Note: The horizontal axis shows the level of the output gap and the vertical axis shows the effect of the output gap on inflation.

The estimation results suggest that the unit contribution of the output gap to core goods inflation is much stronger in times of weak demand conditions (Chart 1). In times of negative output gap, inflation becomes more sensitive to the output gap and the disinflationary effect from the core goods channel becomes more significant. It is concluded that the output gap has a smaller effect on core goods inflation in terms of unit contribution in periods of strong economic activity compared to periods of weak demand.

Calculations for the services group excluding communication are different from the results obtained for the core goods group (Chart 2). The effect of a one unit increase in the output gap on inflation rises with the increase in the level of the output gap. This indicates that a demand-driven inflationary pressure is felt more strongly in the services group during the positive and high output gap. The effect on disinflation is lower in magnitude in times of negative output gap, compared to that of a positive output gap at the same level.

Possible causes of this divergence between the responses to the output gap in core goods and services may first include the differences in competition across services and core goods sectors. Since the core goods sector is more competitive, in periods when demand is high, companies may not go for strong price increases in order not to lose their market shares. Otherwise, consumers may demand lower-priced substitutes for products in a highly diversified sector. In times of negative output gap, besides competitive conditions, the cost of keeping physical stock can be considered as a factor that accelerates the decline in

prices. In the services sector, in times of strong demand conditions, capacity constraints may be more determinant in a non-competitive market structure. Therefore, the inflationary effect of the output gap can be expected to be stronger in the services group in periods when supply growth lags behind demand growth. Moreover, the high rigidity in the services group stemming from the backward indexation behavior and wage inflation stickiness may limit the lowering effect of a weakening in economic activity.

As a result, our findings suggest that the relationship between core goods and services inflation and economic activity may not be linear. Services inflation is more sensitive to the output gap in periods of strong economic activity compared to periods of weak activity. On the other hand, the effect of the output gap on core goods inflation is greater in periods of weak economic activity compared to periods in which economic activity is high. This analysis indicates that contribution of the output gap, which has been on negative territory in 2019, to the downward trend in core goods and services inflation has been about 2.5 and 1.3 percentage points respectively. Considering the contribution of disinflationary effect resulting from the output gap in core goods and services inflation to the fall in annual inflation of index C, which is composed of these two groups, it is inferred that approximately two-thirds of the contribution has stemmed from core goods, and the remaining one-third has arisen from the services group. In this respect, analyzing the inflation-demand relationship by sub-groups and by considering non-linear effects as well, contributes to a more accurate assessment of the impact of the output gap on inflation.

References

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