Technical Appendix to *Chicago Fed Letter* No. 529:
Flash PCE: A Mid-Month Inflation Nowcast

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This appendix provides additional details regarding the Fisher ideal price index, the calculation of the Flash PCE nowcast, and the decomposition of Flash PCE error via conversion to an additive index. The intended audience is advanced undergraduates as well as more experienced economists.

Fisher ideal price index

The BEA constructs the Personal Consumption Expenditures Price Index (PCEPI) using the Fisher ideal method, which combines price changes with expenditure weights from both the current and previous periods. Let the price of good or service i in month t be given by $p_{i,t}$. Then the inflation rate for this good or service is

$$\pi_{it} = \frac{p_{i,t}}{p_{i,t-1}} - 1. \tag{1}$$

Let $s_{i,t}$ be the share of total consumption expenditures spent on good or service i in month t. Then the PCE inflation rate, π_t, is calculated as a Fisher ideal price index, such that

$$\pi_t = \sqrt{\left(\sum_i s_{i,t-1}\left(1+\pi_{i,t}\right)\right)\left(\sum_i s_{i,t}\frac{1}{\left(1+\pi_{i,t}\right)}\right)^{-1}} - 1. \tag{2}$$

Here, the first term in the square root sign is the Laspeyres index formula that captures the price change in the basket of goods and services bought the previous month. The second term is the Paasche index that captures the change in the price of the basket bought in the current month. The Fisher ideal price index takes the geometric average of these two to take into account the change in the composition of the basket.

Calculation of the Flash PCE nowcast

Because current-month expenditure shares, $s_{i,t}$, are not available at mid-month, the Flash PCE model uses lagged expenditure shares as estimates of current expenditure shares, i.e., $\hat{s}_{i,t} = s_{i,t-1}$.

The Flash PCE nowcast is then calculated as

$$\pi_t = \sqrt{\left(\sum_i s_{i,t-1}\left(1+\hat{\pi}_{i,t}\right)\right)\left(\sum_i \hat{s}_{i,t}\frac{1}{\left(1+\hat{\pi}_{i,t}\right)}\right)^{-1}} - 1. \tag{3}$$

This is the Fisher ideal price index formula used for the construction of PCE inflation calculated with our estimates of current expenditure shares and inflation rates across goods and services.

Decomposition of Flash PCE error

Flash PCE error can be decomposed as follows, with ${\pi_t}^{TQ}$ being the Törnqvist index, an additive price index that will allow us to measure the contribution of different components to overall inflation:

$$\begin{aligned}{\hat{\pi}_t}^{PCE} - {\pi_t}^{PCE} &= {\hat{\pi}_t}^{PCE} - {\pi_t}^{PCE} + {\hat{\pi}_t}^{TQ} - {\pi_t}^{TQ} - {\hat{\pi}_t}^{TQ} + {\pi_t}^{TQ} \\ &= \left[({\hat{\pi}_t}^{PCE} - {\pi_t}^{PCE}) - ({\hat{\pi}_t}^{TQ} - {\pi_t}^{TQ})\right] + \left[{\hat{\pi}_t}^{TQ} - {\pi_t}^{TQ}\right].\end{aligned}$$

The first term on the right-hand side is the index mismatch, or the error arising from the difference between the PCEPI and Törnqvist index. The second term is the Törnqvist error, which we can decompose as follows:

$$\begin{aligned}{\hat{\pi}_t}^{TQ} - {\pi_t}^{TQ} \quad &= \frac{1}{2}\sum_i (s_{i,t-1} + \hat{s}_{i,t})(1 + \hat{\pi}_{i,t}) - \frac{1}{2}\sum_i (s_{i,t-1} + s_{i,t})(1 + \pi_{i,t}) \\ &= \textstyle\sum_i (s_{i,t-1})(1 + \hat{\pi}_{i,t}) - \frac{1}{2}\sum_i (s_{i,t-1} + s_{i,t})(1 + \pi_{i,t}) \\ &= \tfrac{1}{2}\textstyle\sum_i \left(s_{i,t-1} + \frac{1}{2}s_{i,t-1} + \frac{1}{2}s_{i,t}\right)(\hat{\pi}_{i,t} - \pi_{i,t}) + \\ &\quad \tfrac{1}{2}\textstyle\sum_i (\hat{\pi}_{i,t} + \pi_{i,t})\left(s_{i,t-1} - \frac{1}{2}s_{i,t-1} - \frac{1}{2}s_{i,t}\right) \\ &= \textstyle\sum_i \left(\frac{3}{4}s_{i,t-1} + \frac{1}{4}s_{i,t}\right)(\hat{\pi}_{i,t} - \pi_{i,t}) + \frac{1}{4}\sum_i (\hat{\pi}_{i,t} + \pi_{i,t})(s_{i,t-1} - s_{i,t}).\end{aligned}$$

The first term on the right-hand side is the error contribution arising from price misses, and the second term is the error contribution arising from misses on expenditure shares.