Mathematical notes

This section provides mathematical formulas to help explain the critique of year-on-year inflation (see also [Eeckhout, 2023](#)). P_t denotes the aggregate consumer price index for the current month. The year-on-year inflation rate, π_t^y, is then derived as the percentage growth in P_t (time t) compared to the same month one year ago (time $t-12$):

$$1 + \pi_t^y = \frac{P_t}{P_{t-12}}. \tag{1}$$

Comparing this measure to the *monthly* growth rate in the CPI is useful. π_t^m denotes the percentage month-on-month growth rate, expressed on an annualised basis:

$$1 + \pi_t^m = \left(\frac{P_t}{P_{t-1}}\right)^{12}. \tag{2}$$

The above equation raises the price ratio to the 12th power to put month-on-month and year-on-year inflation rates on equal footing. Intuitively, π_t^m expresses the inflation rate if the month-on-month price growth is sustained for an entire year. For example, a non-annualised month-on-month CPI growth rate of about 0.165% corresponds to an annualised inflation rate of 2%.

Using these two equations, it is possible to link year-on-year inflation to annualised month-on-month inflation as follows:

$$1 + \pi_t^y = (1 + \pi_t^m)^{\frac{1}{12}} \times (1 + \pi_{t-1}^m)^{\frac{1}{12}} \times \ldots \times (1 + \pi_{t-11}^m)^{\frac{1}{12}}. \tag{3}$$

Therefore, starting from annualised month-on-month inflation rates π_t^m, year-on-year inflation π_t^y can be constructed by appropriately "weighting" the π^m rates by $\frac{1}{12}$. The weight is applied to the month-on-month rates from the current month (π_t^m) until 11 months ago (π_{t-11}^m). Observations from around a year ago thus have the same impact as the current month's data.

By contrast, alternative inflation measures apply different weights to the month-on-month terms in equation (3). Increasing the weight of the most recent data (π_t^m) and reducing the weight of more distant lags make the inflation measure a timelier indicator of price dynamics. However, such changes also tend to increase volatility.

Finally, it should be noted that the calculations and charts in this blog post are based on seasonally adjusted price indices. Without seasonal adjustment, the month-on-month inflation rates would be even more volatile and contain a source of variation that provides no economic insight.