Core Inflation Measurement

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UN ECE-ILO Group of Experts Meeting on Consumer Price Indices,
May 26, 2014, Geneva

What is core inflation?

- Implicit in the concept of core inflation is that inflation is a monetary phenomena, as opposed to a cost-of-living indicator. Transitory relative price shocks should not be allowed to influence core inflation. Core inflation(i) better tracks the underlying or trend inflation rate in real time or (ii) forecast the future headline inflation rate; headline and analytical measures.
- We characterize CPI inflation, π_t , as core inflation, π_t^* , plus a temporary disturbance, i.e.

$$\pi_t = \sum_i w_i \frac{p_i^t}{p_i^0} = \pi_t^* + \upsilon_t$$

where υ_t is random and *normally* distributed.

Who designs, compiles and disseminates it

- Core inflation is usually based on the CPI - a credible, non-revised, timely measure of inflation. Compiled from CPI lower-level series.
- In many countries the central bank is responsible for core inflation measurement.
- In others, responsibility for compilations and dissemination may lie with/be passed to an autonomous statistical authority.
  - central bank has a major role to play in the design of the measure to ensure it meet the needs of monetary policy formulation.
  - central bank may be responsible for **analytical measures**.
- Importance of good relations between the two institutions.
- Need for good metadata on core inflation methods and the reasons for their adoption.

Data: CPI elementary aggregate series

- **Core inflation and the underlying CPI series**
  - Sources of error and bias in a CPI
  - Rebasing and structural breaks
- **Some decisions:**
  - Level of disaggregation
  - Periodicity of comparisons
  - Length of series
- **Getting to know the data:**
  - **What is most important**
    - Look at the CPI weights, where to focus attention – credibility
    - Care in exclusion
- **Getting to know the data:**
  - **Product-specific factors**
    - Regulated products
    - Tax changes
    - Spikes: supply/demand shocks; menu costs
    - Special cases: agric; oil;..
- **Exploratory data analysis**
  - Graphing the series
  - Distribution of price changes
  - Seasonality and seasonal adjustments
  - Cyclical inflation: unusual periods
  - Increased dispersion/volatility and increased rates
  - Outlier detection/treatment: values and series

Exploratory data analysis

- Work at a disaggregated level
- Exclude *changes* in indirect taxes/subsidies
  - For 12–month comparisons, tax/subsidy change effect lasts 12 months. Exclude *effect,* not product. Relatively simple if tax rate.
  - Would include indirect taxes/subsidies change for cost-of–living and inflation CPI. But for core inflation we do not want the non-market spike in prices.
  - Based on unlikely assumption of immediate absorption of tax increase.
- Other changes: e.g. weather-related; abandoning tariff barriers, major exchange rate changes (strip traded goods from index-domestically generated inflation).
- Remove administrative and regulated prices (tiered).
- Distribution of price changes: non-normality of price changes; non-normal distribution, highly peaked (leptokurtic) and skewed to the right.

The distribution of price changes

- For the *normal* distribution, the most efficient (minimum variance) estimator of central tendency is the sample *mean*.
- For *kurtotic* distributions the sample *median* is a more efficient (lower variance) estimator of central tendency (or use a trimmed mean).
- Distributions of price changes typically have positive *skewness*.
  - Use an asymmetric trim to ensure that calculated trimmed mean has the same trend as the mean inflation rate.

Seasonality and seasonal adjustment

- Need to remove seasonality to determine most volatile product groups.
- Can be substantial and vary over sub-periods.
- Use X12/13 program developed by the US. Bureau of the Census – transparent.
- trading day/holiday effects and outliers.

Need to decide on periodicity of comparisons

- 12-Month, m-on-m, (average) q-on-q in previous year, q-on-previous q.
- trade-off between reducing excessive short-term volatility versus capturing current price development. (Annualized) monthly most up-to-date, but volatile.
- Match the periodicity of the inflation target, almost invariably 12-month CPI rate.
- 12-month rates removes some seasonality: useful if determining most volatile products.
- 12-month rates cannot deal with irregular yet periodic price changes, e.g. postage (mail) stamps in December (stable) or varying months (too volatile).
- More than one definition may be used to gain further insights into the underlying process.

The methods:

- **Exclusion-based methods**
  - Product groups
  - Indirect taxes
  - One-off shocks
  - Regulated prices
- **Trend estimates**
- **Limited influence estimators**
  - Median
  - Trimmed means—symmetric and asymmetric
- **Reweighting the CPI**
  - Persistence weights
  - Volatility weights
  - First principal component: dynamic factor models
- **Economic models**

Exclusion, specific adjustment and re-weighting methods

- Exclusion based measures
  - What to exclude:
    - Volatile prices
    - Supply-determined shocks (e.g. regulated prices, weather related)
    - Inappropriate components of CPI (interest rates for housing)
- Specific adjustment
  - One-off shocks:
    - Changes in indirect taxes/subsidies
    - Regulated prices
    - Major exchange rate changes
- Reweighting
  - Idea of double weighting
  - Volatility weighting
  - Persistence weighting
  - Other

Exclusion- based measures

- An appropriate weighting scheme would weight prices by the strength or quality of the underlying inflation "signal" they provide.
- This is the approach that implicitly underlies the widely used "ex. Food & energy" or "ex. indirect taxes" approaches to estimating core inflation. Zero weight is attached to certain prices on the (unstated) grounds that they convey zero information about core inflation.

Exclusion-based methods: volatile prices

- Easy to understand and calculate, timely, transparent (can be replicated), and commonly used.
- Can be quite simple, e.g. exclude fresh fruit, vegetables, and fuels.
- Standard exclusions for headline core inflation are used by a number of countries: advantage less likely to be perceived to be manipulating the core measure.
- Tiered exclusions: "food", then "food and energy" are useful analytically.
- However, deciding on which components to exclude is not straightforward.

Volatility: country-specific data-driven

- What is volatile in one country may not be in another.
- The level of disaggregation matters – only some foods are volatile.
- Data-driven and transparent: determine which products are volatile and the *longevity* of the volatility.
- Objective methods can be used to determine exclusions:
  - E.g. more than one-and-a-half standard deviations from the mean in at least 25 percent of the 12-month rates over a 15-year period;
  - Similarly for trimmed mean, e.g. product groups excluded more than 75 percent of the time by a 15 percent trimmed mean over a given period.
  - Allow exclusions to vary over time, e.g. the 10 most volatile product groups in any period.

But:

- Exclusions should not damage credibility by excluding too much. Weights of excluded items might be better apportioned to product groups likely to experience similar "uncontaminated" price changes.
- Need to consider reasons for volatility (or lack of) —seasonality, measurement problems: old item specifications/outlet sample, unchanging weights for product group.

Excluding food (Walsh IMF Working Paper, 2009)

- Walsh concludes that eliminating food prices from core inflation may provide an incorrect picture of underlying inflation trends, especially in low income countries.
  - core measure of inflation must have the same medium-term mean as the headline measure. However, food inflation is in many countries higher than nonfood inflation.
  - Food inflation in many cases is quite persistent – less volatile - in many [poorer] countries more so than nonfood prices.
  - food inflation in many countries is transmitted into nonfood inflation, particularly in developing economies; a one percent shock to food prices on average results in a 0.15 percent increase in nonfood prices, but in poor countries the average is around 0.3 percent.

Volatility weights

- Exclusion-based methods discard potentially useful information about core inflation. There is also a once-and-for-all judgment about what the least informative categories of prices are for estimating core inflation.
- A volatility-based weighting scheme allows weights to change over time as the volatility of different categories changes; compilers choose the estimation "window" for the standard deviations/variances.
- Standard deviation/variance-based volatility measures are of the difference between 12-month inflation rates for each component and the (weighted) CPI.

Volatility weights

- Volatility weights: can include all sectors but give less weight to those most volatile:

$$\pi_t^* = \frac{\sum_i^n \frac{1}{vol(\pi_i)} \pi_i^t}{\sum_i^n \frac{1}{vol(\pi_i)}}$$

$$vol(\pi_i) = \sigma_i = \sqrt{\sum_t \left[\frac{1}{(n_t - 1)} \left(\pi_i^t - \pi^t \right) - \left(\overline{\pi_i^t - \pi^t} \right) \right]^2}$$

can be double-weighted:

$$\pi_t^* = \frac{\sum_i^n \frac{w_i}{vol(\pi_i)} \pi_i^t}{\sum_i^n \frac{w_i}{vol(\pi_i)}}$$

Persistence weights

- Starting from a definition of core inflation as the persistent or durable component of inflation, individual price changes could be weighted by their ability to forecast future inflation.
- Central bankers should be more concerned about future inflation than they are about past inflation.
- Core inflation as a signal extraction problem: future inflation is the object about which we are seeking information through current signals. Thus core inflation is defined in terms of its ability to predict future headline inflation.

Persistence weights

- **Persistence weights** give more weight to product groups considered best able to forecast the target.

$$\pi_t^* = \frac{\sum_{i \in \rho_i > 0} \hat{\rho}_i \pi_i^t}{\sum_{i \in \rho_i > 0} \hat{\rho}_i} \qquad \pi_i^t = \alpha_i + \rho_i \pi_i^{t-12} + \varepsilon_i^t$$

can be double-weighted:

$$\pi_t^* = \frac{\sum_{i \in \rho_i > 0} w_i \hat{\rho}_i \pi_i^t}{\sum_{i \in \rho_i > 0} w_i \hat{\rho}_i}$$

Persistence weights

- Based on times series properties of disaggregated components as opposed to cross-sectional analysis.
- Weights are constant over fixed time intervals; practice is to allow weights to change each year. This is implemented by estimating the equation recursively adding an extra year's worth of data and updating the persistence coefficient as we go forward in time.
- If $\hat{\rho}_i$ is negative, then the persistence coefficient is equal to zero. The weights are normalized to sum to one.
- Double -weighting prevents a component that is highly persistent, but is relatively unimportant, from dominating the forecast.

Persistence weights

- Many alternative formulations, specifically:

$$\pi^t = \alpha + \beta_1 \pi_1^{t-12} + \beta_2 \pi_2^{t-12} + ,..., \beta_i \pi_i^{t-12} + \varepsilon_i^t$$

- This "optimal" weighting finds the coefficients for each component, estimated jointly, that provide the best fit for forecasting. The core measure is a β_i weighted average of lagged inflation.

How to choose between measures: general considerations

- timely
- credible (verifiable)
- easily understood by the public
- and not significantly biased (robust) with respect to the targeted measure
- have a track record of some sort
- have some theoretical/intuitive basis
- not be subject to revisions.

Judging which method to use

- Judging on the basis of tests:
  - *Unbiasedness*
  - *Cointegration.*
- Justifying the exclusion of products on the basis of their volatility.
- Judging core on the basis of deviations from a smoothed reference CPI series:
  - *MAD and/or RMSE against 36 month moving average.*
- Judging core on the basis of predictive ability of CPI:
  - *MAD and/or RMSE against predicted value*
  - *Over and above* that of the current CPI
  - Cogley test.

Concluding points

- More than one measure to suit different purposes
- Headline measure usually exclusion-based
- Tiered exclusions for analytical and explanatory purposes
- Updating of exclusions/adjustments/ weights
- Objective transparent justification, usually data-driven

Concluding points

- The empirical research shows that **different measures** yield different results, that is, that choice of measure matters.
- Further, that different approaches to **the choice of measure** yield different results.
- Even for the same approach to choice, the preferred measure may differ across countries, and even within a county for different time periods.
- Choice of measure should thus, in principle, be research-based and data-driven based on appropriate criteria.
  - Research is required to establish and develop core measures based on sound statistical criteria. This includes choice of what to exclude.
  - It is important to publish studies of alternative methods and the criteria used to choose among them.