

Box B: Alternative Measures of Inflation in Singapore

Introduction

Most central banks, with the primary objective of achieving low and stable inflation, construct and monitor several measures of underlying or core inflation. Such measures generally aim to tease out persistent, “core” price movements and distinguish these from price changes driven by more temporary disturbances or “noise”. Policymakers must focus on the persistent trend in prices because monetary policy only transmits to prices with a lag; it would neither be possible nor ideal for monetary policy to respond to erratic changes in a narrow set of prices. Measures of inflation that capture broad-based, persistent trends in prices would be better guides for monetary policy. In addition, some measures of core inflation also explicitly exclude price fluctuations from non-monetary sources so that the resultant measure of inflation can be better seen as an outcome of monetary policy. Such measures may therefore serve as operational targets for which central banks can be held accountable.

While MAS looks at a broad range of price and cost indicators in the economy, MAS Core Inflation is the measure that is monitored most closely in formulating monetary policy. MAS Core Inflation excludes accommodation and private road transport prices, as these components are often driven by administrative supply-side changes and can be more volatile than most other components of CPI. At the same time, MAS Core Inflation includes food and utilities because these prices can be directly influenced by MAS’ exchange rate-based monetary policy. Food and utilities prices are salient to all households, whereas car prices and market rents of residential accommodation have little impact on the day-to-day cash outlays of most Singaporeans.¹

Central banks have found value in incorporating several measures of core inflation in their policy analysis and formulation, as no one measure of inflation will be a superior guide to policy in all circumstances (Ehrmann *et al.*, 2018, Bullard, 2011). The experience of high inflation over the 2021–23 period, involving a complex combination of supply and demand shocks whose effects are of varying persistence, highlights the importance of having alternative measures of underlying inflation to support policy formulation. This box item examines a variety of underlying inflation measures that may serve as useful guides to monetary policy in Singapore.

Alternative Inflation Measures

There are several different approaches to measuring core inflation that are commonly used internationally (**Table B1**):

¹ A significant share of accommodation costs in the CPI is the cost of “owner-occupied accommodation”, which is meant to reflect the costs to homeowners of utilising the flow of services provided by their homes. This is proxied by market rents. However, this indicator has no direct impact on the monthly cash expenditure of most households as most Singaporeans own their homes and do not pay housing rent. Meanwhile, private road transport costs are significantly influenced by the prevailing prices of “Certificates of Entitlement” (COEs) determined under the vehicle quota system. Again, the majority of households would not be frequently affected by changes in COE prices as most car buyers have a long interval between car purchases, in line with the 10-year validity for most COEs.

Table B1 Measures of core inflation

Inflation Measure	Type	Description
MAS Core Inflation	Exclusion-based	Excludes accommodation and private road transport prices
CPI ex Fresh Food and Energy (XFE)		Excludes fresh food and energy prices
CPI Volatility-Adjusted (VA)	Volatility-adjusted	Weights of components adjusted based on relative volatility (more volatile components are given smaller weight)
Weighted Median	Limited influence	Median price series by degree of price change
10% Trimmed Mean (T10)		Top 10% of extreme price changes are removed
25% Trimmed Mean (T25)		Top 25% of extreme price changes are removed

- **Exclusion-based measures.** These measures systematically exclude some specific components of the CPI that are regarded as being highly volatile, reflecting their susceptibility to supply shocks. This category includes the MAS Core Inflation measure as well as a commonly used measure of core inflation internationally that removes fresh food and energy prices from the CPI.
- **Volatility-adjusted (VA) measures.** This type of measure increases or decreases CPI expenditure weights in proportion to the relative volatility of CPI components over a particular period. The measure constructed for Singapore adjusts the component weights for the relative variance in 3-month, seasonally adjusted group-level price changes. Items that were found to be particularly volatile and down-weighted include telecommunications equipment, private transport, other transport services, and utilities and fuels. Items that have low volatility and are up-weighted include an array of food components with a high service content (e.g., hawker food and restaurant meals), as well as personal services items (e.g., holidays and telecommunication services).
- **Limited influence measures.** These include the weighted median and trimmed-mean measures, and involve replacing extreme price changes, on both ends, with the weighted average of the remaining prices, on a period-by-period basis. Unlike the exclusion-based or VA measures, the items excluded from the calculations vary across time, which makes them robust to a wide range of shocks. In this analysis, three measures are calculated based on seasonally adjusted group-level price changes over 3 months: the weighted median; a 25% symmetrically trimmed mean; and a 10% symmetrically trimmed mean.

The data used in this analysis have three important characteristics:

- **Aggregation.** Data used are at the group level of aggregation, which consists of 42 categories of prices in Singapore's CPI basket. This level of aggregation was selected for two main reasons. First, it is the most detailed level of aggregation that is publicly available, so that core inflation measures derived from this can be externally verified. Second, the level of aggregation is detailed enough for analytical purposes, but not so granular that it would complicate policy communication.

- **Frequency.** The analysis focuses on price changes over 3 months. Price changes over 12 months are relatively smooth but are slow at catching turning points. Month-to-month price changes catch turning points quickly but are noisy. Accordingly, the 3-month price changes strike a balance between immediacy and smoothness and facilitate analysis and communication in conjunction with quarterly GDP data.
- **Seasonal adjustment.** All data used are seasonally adjusted by the Department of Statistics (DOS).

Historical Behaviour of Alternative Inflation Measures

Table B2 shows average rates of inflation and volatility indicators for the CPI-All Items (headline), MAS Core and alternative core inflation measures over the period 2004–23. All inflation series presented in this Box are end-of-period quarterly values, as the information content in these more up-to-date indicators is arguably more useful to policymakers.

- The average reading for most alternative measures of core inflation was 0.3–0.4% point below that of the headline CPI rate, but generally only slightly lower than MAS Core. Among the alternative measures, the average reading for the 10% trimmed mean measure was closest to the headline rate.
- Most measures of core inflation were significantly less volatile than CPI-All Items inflation. For the headline rate, the volatility of the changes in the quarterly inflation rate was 0.7% point. MAS Core Inflation and CPI XFE were about 10% less volatile, while the CPI VA, trimmed mean and weighted median measures were 40–50% less volatile. This also translated into lower volatility in y-o-y inflation rates.

Table B2 Average inflation and inflation volatility (2004–23)

Inflation Measure	Average YOY CPI Inflation Rate (%)	Inflation Volatility (Standard Deviations)	
		Change in QOQ Inflation Rate (% Point)	Change in YOY Inflation Rate (% Point)
CPI-All Items (Headline)	2.1	0.7	0.9
MAS Core Inflation	1.9	0.6	0.8
CPI ex Fresh Food and Energy (XFE)	1.7	0.6	0.9
CPI Volatility-Adjusted (VA)	1.8	0.4	0.6
10% Trimmed Mean (T10)	2.1	0.4	0.7
25% Trimmed Mean (T25)	1.8	0.4	0.6
Weighted Median	1.7	0.3	0.6

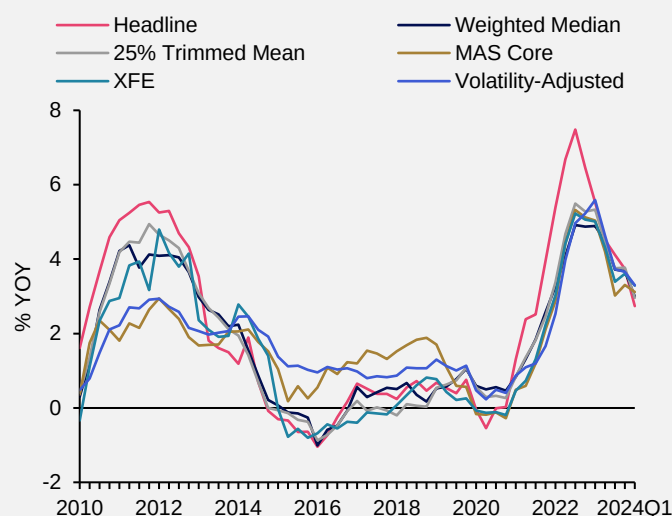
Source: EPG, MAS estimates.

Note: Based on end-of-period price changes over 2004–23 for each measure of inflation. Y-o-y inflation for MAS Core is computed using the non-seasonally adjusted series published by MAS. Volatility statistics for MAS Core Inflation are instead calculated using a weighted average of the seasonally adjusted components of MAS Core and differ from those calculated using the non-seasonally adjusted series.

Chart B1 shows the historical time series for the various alternative core inflation measures, alongside MAS Core and CPI-All Items inflation measures. The alternative

measures mostly track MAS Core Inflation well, although there have been periods where MAS Core has been lower (e.g., 2011), as well as higher (e.g., 2017–18).

Chart B1 Inflation rates



Source: DOS and EPG, MAS estimates

Note: Lines depict y-o-y inflation rates on an end-of-period basis.

The trimmed mean inflation measures remove outlying components registering relatively high or low inflation and can deviate from MAS Core Inflation under two scenarios.

- When accommodation or private road transport inflation rates are close to the median and are not excluded, the trimmed mean measures can deviate from MAS Core if the price changes of the trimmed components differ substantially from those of accommodation and private transport. This occurred for example in H2 2014 when accommodation inflation was low and relatively stable, and was often included in the trimmed mean measures. Meanwhile, several components, such as fresh food, saw large spikes in prices and were excluded, leading to the trimmed mean coming in lower than MAS Core Inflation.
- When accommodation and private road transport prices are excluded by trimming, the trimmed mean measures can deviate from MAS Core if there is a large distance between the price changes of the other trimmed components and the remaining non-trimmed ones. For example, from 2017–18, utilities showed strong price increases compared to the median and were frequently excluded from the 25% trimmed mean measure together with accommodation and private transport. Consequently, the trimmed mean measures were substantially lower than MAS Core. Conversely, from 2010–13, components such as recreation and telecommunication equipment saw large declines in prices that were not in line with most other price trends. This led to their exclusion and the trimmed mean measures coming in above MAS Core Inflation.

The CPI VA index retains all components in the CPI-All Items index but down-weights both accommodation and private transport due to their relatively high levels of volatility. It also down-weights other volatile components, such as utilities, and up-weights CPI components whose prices move more smoothly.

- During periods when up-weighted components experience very high or low inflation outturns, the CPI VA measure can diverge from MAS Core Inflation. For example, in 2015, when prices in the tuition & other fees category, which is significantly up-weighted in the CPI VA index due to its low historical volatility, rose strongly, this caused VA inflation to be higher than MAS Core Inflation.
- Likewise, when price changes of the other down-weighted components are different from accommodation and private transport, the CPI VA measure can deviate from MAS Core Inflation. For example, when utilities & other fuels, which is down-weighted due to its relatively volatile nature, experienced over 10% y-o-y inflation in 2018, VA inflation fell below MAS Core Inflation.

Overall, instances of divergences between MAS Core Inflation and the alternative core measures can contain useful economic information on the nature of current price increases and outlook for future inflation. In this regard, recent inflation outturns may provide a useful case in point.

While all alternative measures had tracked MAS Core Inflation very closely from the onset of COVID-19, there has been a slight divergence in the most recent data. In Q1 this year, MAS Core Inflation in y-o-y terms showed only a modest decline of 0.2% point from a quarter ago, while the 25% trimmed mean and VA inflation fell by a larger extent (0.8% and 0.4% point respectively). This reflected large price increases for a few components in MAS Core that are infrequently adjusted, such as public transport and healthcare. Public transport fares are only adjusted once a year at the end of December, and prices were adjusted in end-2023 to catch up with earlier cost increases. Consequently, there was a step-up in public transport inflation in Q1 2024 even as inflation in most other CPI components continued to ease. The continuing moderation in the bulk of price changes in the CPI and that of lower-volatility components suggests that underlying inflation remains on a broad easing trend.

Empirical Assessment of Alternative Inflation Measures

The approach proposed by Cogley (1998) is employed to evaluate the predictive power of alternative inflation measures on future (“target”) MAS Core Inflation and headline inflation. It assumes that the current deviation of underlying inflation from target inflation (either MAS Core or CPI All-Items) should be inversely related to subsequent changes in target inflation. Thus, if a measure indeed captures underlying trend inflation and the target inflation is above (or below) trend, the target series should correct itself by falling (or rising) over time. The test uses a regression of the following form:

$$\pi_{t+L}^T - \pi_t^T = \alpha + \beta(\pi_t^T - \pi_t^U) + \varepsilon_t$$

where π_t^T represents target inflation, π_t^U represents the underlying inflation series, and β measures the degree to which the transitory component is corrected over time. If this component is fully captured, the coefficient β should be close to -1.

Two sets of results are presented in this section. The first set configures MAS Core Inflation as the target inflation series and provides insights into whether the alternative inflation series contain informational content for predicting MAS Core Inflation. The second set uses CPI-All Items inflation as the target and presents a more conventional interpretation of identifying whether the underlying inflation series are effective in stripping out the transitory and volatile components of headline inflation.

The estimates show that CPI XFE is ineffective in predicting the future path of MAS Core Inflation (**Table B3**). This result is not unexpected, as there is little overlap between the excluded components of CPI XFE and MAS Core. The excluded components themselves are also unlikely to be driven by the same underlying shocks. Meanwhile, the estimated β coefficients for the trimmed mean and CPI VA indices are statistically significant and negative, though the trimmed mean measures tend to overstate future core inflation while the CPI VA measure appears to understate it. In terms of their goodness of fit as indicated by the equation R^2 , CPI VA performed best, followed by the weighted median and trimmed mean measures.

Table B3 Results from Cogley Test for predictive power (MAS Core Inflation as target)

Forecast Length = 8 Quarters	β	R^2
Weighted Median	-0.72* (0.19)	0.16
10% Trimmed Mean	-0.57* (0.18)	0.11
25% Trimmed Mean	-0.65* (0.19)	0.14
CPI ex Fresh Food and Energy (XFE)	-0.11 (0.27)	-0.01
CPI Volatility-Adjusted (VA)	-1.19* (0.26)	0.22

Source: EPG, MAS estimates

Note: * Statistically significant at the 5% level. Standard errors in parentheses.

Results using headline inflation as the target suggest that all measures of underlying inflation are effective in removing the transitory components of headline inflation (**Table B4**). Both MAS Core Inflation and CPI XFE tend to understate future headline inflation. The trimmed means and weighted median measures overstate future headline inflation slightly, while the CPI VA measure neither overstates nor understates future headline inflation. In terms of the goodness of fit, the CPI VA, weighted median and trimmed mean measures tend to outperform the exclusion-based measures.

Table B4 Results from Cogley Test for predictive power (CPI-All Items Inflation as target)

Forecast Length = 8 Quarters	β	R^2
Weighted Median	-1.15* (0.22)	0.28
10% Trimmed Mean	-1.14* (0.26)	0.21
25% Trimmed Mean	-1.23* (0.25)	0.25
MAS Core Inflation	-0.67* (0.21)	0.12
CPI ex Fresh Food and Energy (XFE)	-0.63* (0.30)	0.05
CPI Volatility-Adjusted (VA)	-1.01* (0.20)	0.26

Source: EPG, MAS estimates

Note: * Statistically significant at the 5% level. Standard errors in parentheses.

Sum-Up

In conclusion, the analysis in this box suggests that alternative measures of underlying inflation can help provide a clearer picture of the general trend of inflation. In particular, the weighted median, trimmed mean and CPI VA measures can help to corroborate trends in MAS Core Inflation, or alert policymakers to movements in specific components of the MAS Core basket that may be less representative of current inflation. As such, these alternative measures have a valuable place in the suite of price indicators monitored by MAS for use in monetary policy formulation and communication.

References

- Bullard, J (2011), "Measuring Inflation: The Core is Rotten", *Federal Reserve Bank of St. Louis Review*, Vol. 93(4), pp. 223–233.
- Cogley, T (1998), "A Simple Adaptive Measure of Core Inflation", *Federal Reserve Bank of San Francisco Working Paper* No. 98-06.
- Ehrmann, M, Ferrucci, G, Lenza, M and O'Brien, D (2018), "Measures of underlying inflation for the euro area", *ECB Economic Bulletin*, Issue 4/2018.
- Macklem, T (2001), "A New Measure of Core Inflation", *Bank of Canada Review*, Autumn 2001, pp. 3–12.
- Monetary Authority of Singapore (1998), "Measures of Core Inflation for Singapore", *Monetary Authority of Singapore Occasional Paper* No. 10.
- Monetary Authority of Singapore (2011), "A Review of the Core Inflation Measure for Singapore", *Monetary Authority of Singapore Staff Paper* No. 51.