

Underlying Inflation at its Core

Introduction

Headline inflation may not always reflect the underlying path of prices in the domestic economy. This is because the CPI basket includes items which may experience temporary price volatility due to short-lived shocks such as supply chain disruptions or geopolitical events. This makes it difficult to discern the underlying 'signal' of inflationary pressures using headline inflation alone.

At the same time, it is crucial for central banks to be able to monitor this underlying trend of inflation to guide monetary policy, apart from other factors. Interest rates are a blunt tool that affects the economy as a whole and cannot meaningfully influence changes in individual relative prices,¹ which reflect demand and supply conditions for specific items. As such, monetary policy primarily focuses on managing broad-based risks which affect price stability over the medium-term horizon rather than reacting to temporary price movements which affect a small subset of items. This motivates the use of underlying inflation measures to identify the more persistent trend of inflation which matters for monetary policy considerations.

This article provides an update on underlying inflation measurements used by Bank Negara Malaysia (BNM), as previously detailed in the 2008 BNM Annual Report box article '*Core Inflation: Measurements and Evaluation*'. The article explains how underlying inflation plays a critical role in guiding monetary policy. It delves into how underlying inflation is disentangled from temporary price shocks by analysing various estimation methods, as well as the importance of having a nuanced reading of the data so that monetary policy is appropriately calibrated in line with medium-term price stability.

What is underlying inflation and how is it measured by central banks?

Conceptually, underlying inflation cannot be directly observed and must be estimated by filtering out the transitory and idiosyncratic elements from headline CPI inflation.

There are various methods of estimating underlying inflation, which can be grouped into three broad categories: permanent-exclusion-based measures, statistical-exclusion-based measures and model-based measures (Banbura et al., 2023). Generally, all these measures aim to remove short-term volatile CPI components to reveal the underlying trend in the general price level, which corresponds to macroeconomic factors, such as excess demand or tightness in the labour market. Such factors can generate more widespread and persistent inflationary pressure (Banbura et al., 2023). These are the price conditions that are most responsive to changes in interest rates.

¹ Relative price movements reflect the price changes of individual items or segments in the CPI basket, which may be driven by idiosyncratic factors rather than reflecting broader trends affecting the general price level.

Table 1: Definitions of Key Underlying Inflation Indicators Monitored by Bank Negara Malaysia

Estimation method	Measure	Definition
Permanent-exclusion-based measures	CPI excluding fresh food and energy; CPI excluding fresh food and price-administered items	Excludes items which are known to be more volatile in nature, or where price movements typically reflect temporary, item-specific factors.
	Trimmed mean	Excludes items with the highest and lowest annual change each month (e.g. top and bottom 15% of the weighted distribution of annual CPI price changes). ¹ The excluded items can change over time.
Statistical-exclusion-based measures	Weighted median	Retains the item located at the mid-point of the weighted distribution ¹ of annual CPI price changes each month.
	Double weighted	Assigns a lower weight to highly volatile CPI items and more weight to items that are less volatile.
Model-based measures	Common inflation	Captures the 'common' co-movement of the prices of goods and services across the CPI basket.
	Supercore inflation	Weighted aggregated index of CPI items with statistically significant relationship to economic slack, ² as measured by the output gap.

¹ Under the trimmed mean method, 125 CPI items are arranged in ascending or descending order based on their weighted annual CPI change. The trimmed mean measure then excludes the items within the top or bottom 15% tails of this distribution. Similarly, the weighted median measure retains the item at the mid-point of this distribution.

² Refers to the amount of resources in the economy that are not being utilised, such as idle capital inputs or unemployed persons, due to insufficient demand relative to what the economy is capable of producing (Source: ECB).

Source: European Central Bank (ECB) Economic Bulletin Issue 4/2018 and Bank Negara Malaysia

In the official compilation by the Department of Statistics, Malaysia (DOSM), core inflation is measured as a permanent-exclusion-based measure of CPI. It permanently excludes specific CPI categories such as fresh food and price-administered items.² Similarly, for our published forecast of core inflation, BNM uses the permanent-exclusion-based measure.³ Statistical authorities typically favour publishing permanent-exclusion-based measures of underlying inflation as they are relatively easy to compute and understandable by the public. However, it should be noted that there is no singular best measure of underlying inflation. Each method has its own set of strengths and weaknesses. Analysing the various measures holistically can reveal different features of the underlying price trends, allowing for a more nuanced picture of the inflationary environment at hand.

What can the various measures tell us about underlying inflation dynamics in Malaysia?

Permanent-exclusion-based measures exclude a certain fixed set of items where prices tend to be more volatile and idiosyncratic, such as energy or fresh food. By doing so, these measures are meant to capture the more persistent trend in inflation. However, as the choice of excluded items is fixed, it is still susceptible to idiosyncratic trends in the retained CPI items, particularly those with large weights. For example, food-related items⁴ make up close to 30% of the core CPI basket. Their prices are influenced by factors such as global commodity prices and weather conditions. During times when the prices of these items diverge from broader core CPI prices, this could distort the signal of underlying inflation.

Additionally, while most countries compile some measure of core inflation based on permanent-exclusion-based methods, the exact choice of excluded items may differ across countries. This affects cross-country comparability.

² These include price-controlled food, alcoholic beverages and tobacco, utilities and energy, and transport services. In total, core CPI items have a weight of 73.7% of the overall CPI basket with the excluded components taking up a 26.3% weight. (Source: DOSM CPI Monthly Report, page 126). From January 2024, DOSM CPI data has been updated with new consumption weights based on Household Expenditure Survey (HES) 2022 and classifications based on Classification of Individual Consumption According to Purpose (COICOP) 2024. The analysis in this article are based on the previous conventions used from 2018-23.

³ BNM's official economic forecasts are typically communicated during the release of its Economic and Monetary Report in March of each year, though the projections are periodically updated during the year.

⁴ This includes food away from home, selected food at home, non-alcoholic beverages and expenditure in restaurants and cafes. Together, these categories make up a combined weight of 29.2% of the core CPI basket.

Table 2: Choice of Items Excluded from Headline CPI Basket to Form Core CPI Basket

Countries	Excluded items
US (Core CPI)	<ul style="list-style-type: none"> Food – food at home, food away from home Energy – energy commodities, energy services
UK (Core CPI)	<ul style="list-style-type: none"> Food Energy Alcohol and tobacco
EU (Core HICP)	<ul style="list-style-type: none"> Energy Food Alcohol and tobacco
Japan (Core CPI)	<ul style="list-style-type: none"> Fresh food
Philippines (Core CPI)	<ul style="list-style-type: none"> Food Energy-related items
Malaysia (Core CPI)	<ul style="list-style-type: none"> Fresh food Price-administered items
Indonesia (Core CPI)	<ul style="list-style-type: none"> Volatile food Price-administered items
Singapore (Core CPI)	<ul style="list-style-type: none"> Accommodation Private road transport
Thailand (Core CPI)	<ul style="list-style-type: none"> Fresh/raw food Energy

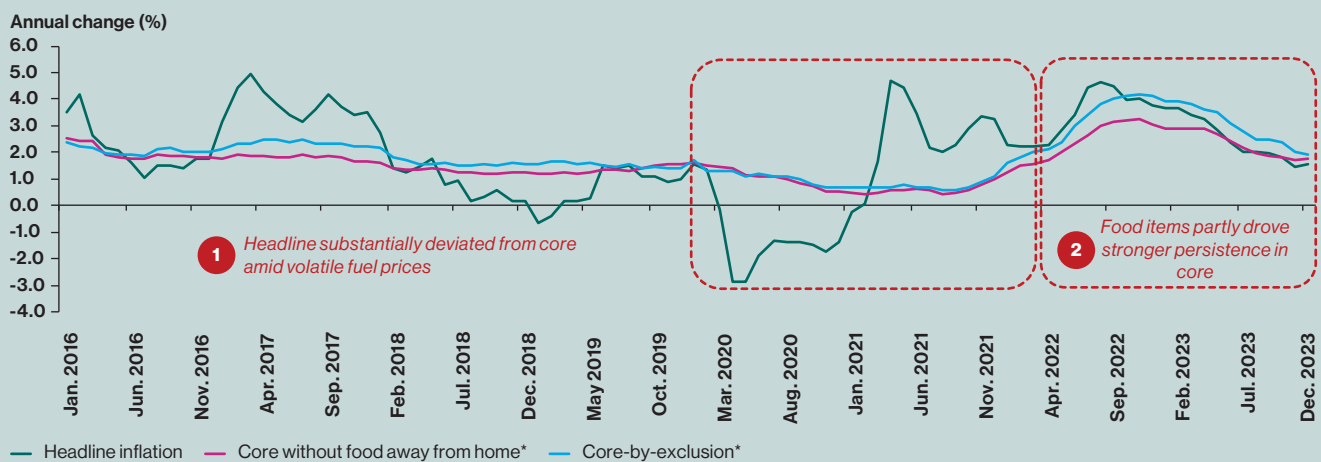
Source: Central bank websites and national statistical agencies

Case Study 1: Malaysia’s experience through the COVID-19 pandemic (2020–23)

Permanent-exclusion-based measures (henceforth referred to as ‘core-by-exclusion’) are able to isolate items that are well known to be volatile outliers within the CPI basket. Fuel is a clear example of this.

- From Chart 1, there was a large divergence between headline and core inflation when global oil prices fell sharply and subsequently recovered in 2021. While core-by-exclusion remained relatively stable, headline inflation surged largely due to fuel inflation. This was driven by short-term shocks to crude oil prices, which were highly volatile due to uncertainties arising from global movement restriction measures during the pandemic.

Chart 1: Headline and Core Inflation



*Excludes the estimated direct impact of tax policy changes.

Source: Bank Negara Malaysia estimations based on Department of Statistics, Malaysia

- However, core-by-exclusion remains heavily influenced by movements in individual CPI categories such as food⁵ – which may in turn be largely driven by idiosyncratic supply factors. This may obscure the underlying price trend. When food away from home is filtered out, we can see that it contributed around 0.6ppt to 1ppt to core inflation from June 2022 to October 2023 (Chart 1: Core by exclusion vs Core without food away). This indicates that the outlook for core-by-exclusion is highly sensitive to movements in food prices (particularly food away from home), despite fresh food and administered food items being excluded. This also suggests that some idiosyncratic shocks which spur large movements in food prices would also distort core-by-exclusion. Going forward, the planned rationalisation of subsidies and price controls on food items could potentially exert material cost-push pressure to core CPI inflation.

Statistical-exclusion-based measures (Chart 2) remove price-volatile outliers on a time-varying basis. For example, trimmed mean inflation simply excludes the top and bottom 15% of price movements⁶ in the CPI basket during a given period in its aggregation of inflation. This can be advantageous as it is agnostic on the exact components that are excluded every month, but consistent on the treatment of outliers (i.e. always the tails of distribution). Measures like trimmed mean and weighted median can offer more precise estimations of underlying inflation during periods with significant outliers. This is because they rely on rule-based criteria rather than discretion-based choices in the exclusion of CPI items.

Chart 2: Core Inflation (Permanent-Exclusion-Based Measure) and Statistical-Exclusion-Based Measures of Underlying Inflation



Note: All the measures exclude the estimated direct impact of tax policy changes.

Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

Unlike permanent-exclusion-based measures, statistical-exclusion-based measures can identify and omit isolated price fluctuations in typically stable items. For example, motorcars are a typically stable component within the core CPI basket, but experienced a negative idiosyncratic price movement in June 2020 (month-on-month change: -1.5%) following the implementation of tax exemptions on motor vehicles. This was omitted in statistical-exclusion-based measures but not in permanent-exclusion-based core inflation.

However, to its disadvantage, it is difficult to effectively communicate trends in statistical-exclusion-based core inflation to the public. Namely, the changing set of excluded items from one period to another could pose interpretation challenges, as they may not provide a consistent explanation for the drivers of relative price movements.

⁵ Includes items such as food away from home, rice, bread and bakery products, milk and biscuits.

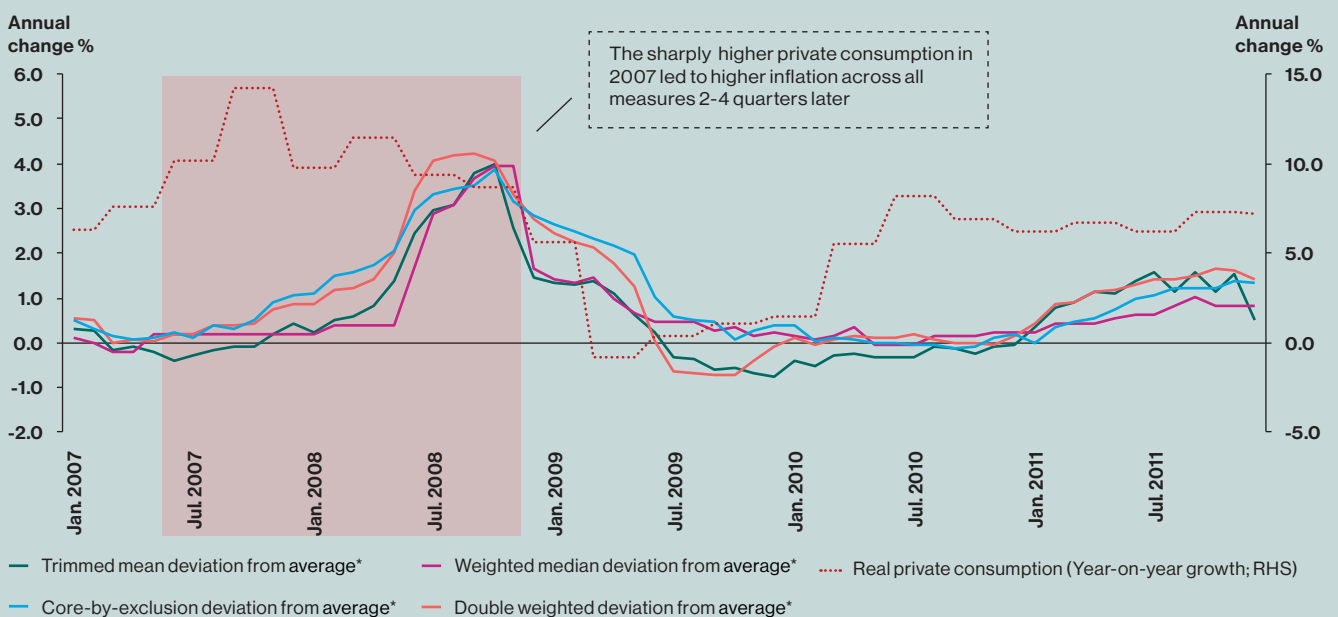
⁶ Items at the tails are deemed to have higher volatility and are outliers as compared to the price movements of the majority of items.

Case study 2: Comparing Malaysia's experiences during the global financial crisis (2007–11) and COVID-19 (2019–23)

Comparing the three statistical-exclusion-based measures in the period around the global financial crisis (2007–11) and the COVID-19 period (2019–23), it can be observed that their movements typically show similar trends but at times deviate from permanent-exclusion-based core inflation. Contrasting these measures may provide us with a more nuanced understanding about the underlying inflation dynamics at play.

- For the global financial crisis (GFC) period (Chart 3), underlying inflation as measured by core-by-exclusion and all three statistical-exclusion-based measures showed similar trends. An increase in the first half of 2008 can be seen across all measures, following the strong demand pressures mainly from high real private consumption growth and exacerbated by the knock-on effects from fuel price shocks. This signals that demand pressures generated broad-based impetus to underlying inflation. Thereafter, all the measures declined in line with the sharp contraction in demand amid the global financial crisis, and to some extent, the reversal of the high energy prices. These dynamics reflect that the inflationary pressure was broad-based, and the underlying factor (i.e. excess demand coinciding with high costs) affected all CPI items, a trend captured by both statistical-exclusion-based and core-by-exclusion measures.

Chart 3: GFC period: Inflation Deviation from 5-year Average (2003–07)



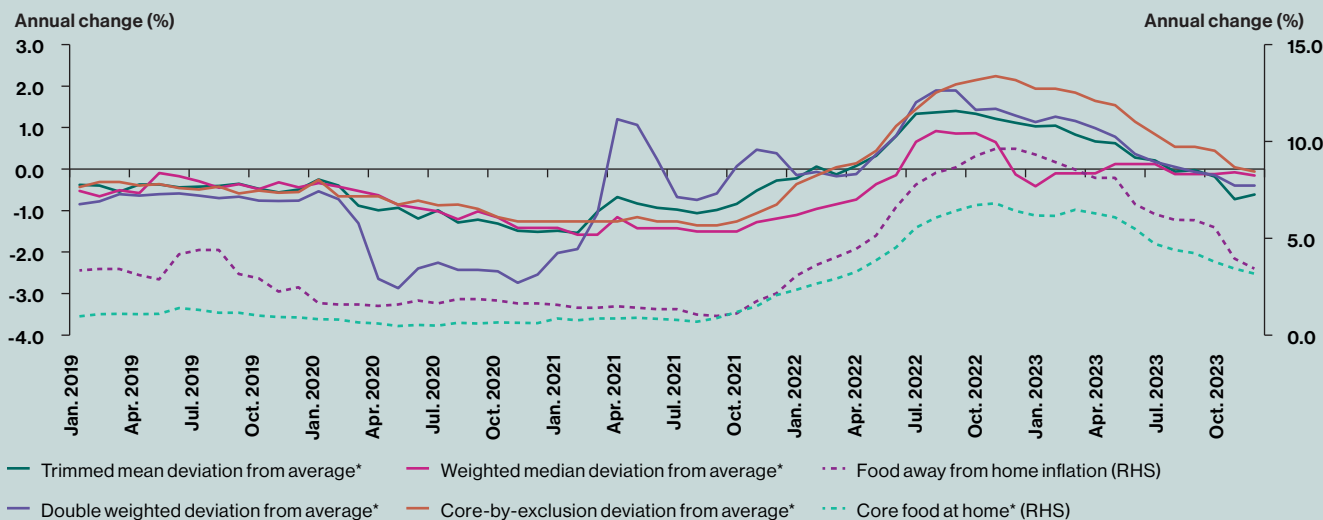
* Excludes the estimated direct impact of tax policy changes.

Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

In contrast, in 2022–23 (Chart 4), core-by-exclusion and statistical-exclusion-based measures showed diverging trends. As explained earlier, the higher and more persistent trend of core-by-exclusion partly reflected the large weight of food-related items, which experienced more durable price pressure compared to the rest of the CPI basket. As some of these movements are outliers to the overall CPI basket, they are excluded by the three statistical-exclusion-based measures. As a result, the underlying inflation based on these statistical-exclusion-based measures returned to average levels more swiftly than the more conventional core-by-exclusion. This is in line with lower pervasiveness⁷ of CPI inflation in 2023, which eased to long-term average levels in the first half of 2023 (Chart 5).

⁷ Based on the month-on-month price changes for 125 CPI items at the 4-digit level.

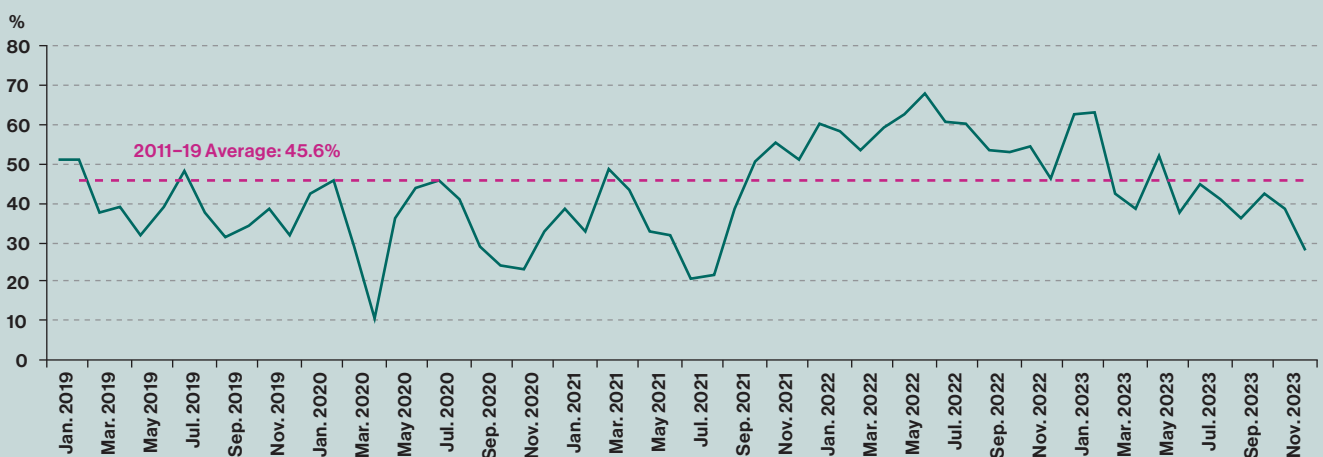
Chart 4: COVID-19 Period: Inflation Deviation from 5-year Average (2015–19)



* Excludes the estimated direct impact of tax policy changes.

Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

Chart 5: Inflation Pervasiveness: Share of CPI Items Recording Monthly Price Increase



Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

Model-based measures utilise relationships from economic theory to capture the persistent aspect of inflation more rigorously. These measures use empirical techniques to filter out the transitory component and isolate certain desired features of underlying inflation. In some cases, they aim to more precisely reflect the co-movement of prices or dynamics driven by business cycle developments.

Two notable model-based measures are common inflation and supercore inflation.

Common inflation uses a data-driven approach to isolate the shared trend that drives co-movement in CPI prices, while excluding the impact of sector-specific disturbances. Similar to the other measures, this is another way of capturing the broad price changes driven by macroeconomic factors, such as the strength of the economy or broad-based cost shocks⁸. This method effectively filters out an idiosyncratic component driven by item-specific outliers to the broader inflation trend and provides a clearer signal of the general trend in CPI inflation to inform monetary policy.

(For more details refer to the Second Quarter of 2023 BNM Quarterly Bulletin box article '*Understanding Inflation Drivers: Differentiating Common and Idiosyncratic Dynamics in Malaysia*').

- **Methodology:** A dynamic factor model⁹ is used to estimate the common component from the individual inflation rates of 125 disaggregated CPI items.¹⁰ Each inflation series is separated into a common and an idiosyncratic component, which is then aggregated, forming the common inflation¹¹ and idiosyncratic inflation series.

Case study 3: Malaysia's experience with common and idiosyncratic inflation (2011–23)

Observable increases in common inflation often coincide with periods of strong real economic growth and pronounced cost pressures, as seen in 2011 and 2022. This observation underscores the close relationship between common inflation and economy-wide factors, with the sensitivity of common inflation especially heightened during shifts in aggregate demand conditions. The recent rise in headline inflation following the recovery from the COVID-19 pandemic was primarily driven by the common component, which contrasted with historical instances where fluctuations in headline inflation were mainly fuelled by idiosyncratic shocks (Chart 6). In 2022, the increase was driven by the combination of global cost factors and the rebound in domestic demand, as the country eased containment measures. This affected a broader range of consumer prices, resulting in a swift uptick in common inflation.

Although common inflation captures broad-based price shocks, it is unable to isolate whether the shocks are driven by cost factors or cyclical demand conditions – given that it is constructed based on co-movements in CPI prices regardless of the source of price shocks.

Supercore inflation,¹² like the permanent-exclusion-based core inflation measures, excludes components where price movements have a lesser bearing on monetary policy. Notably, it draws an explicit link to macroeconomic conditions by constructing a narrower core-by-exclusion index which only retains CPI items which exhibit a significant relationship with economic slack. This allows the measure to more effectively gauge the strength of demand pressure on inflation.

- **Methodology:**¹³ Based on a linear regression of disaggregated CPI items, we retain items that exhibit a statistically significant coefficient of the output gap, after controlling for other cost factors. Overall, around half of the core CPI basket, by weight, are sensitive to the output gap. These items are mainly services such as food away from home and rental.

⁸ This differs from typical supply shocks which are transient and affect a smaller subset of prices. In particular, it refers to episodes whereby cost shocks induce higher input prices across a wide variety of consumer items. For example, the multiple cost shocks in 2022, arising from global value chain disruptions, higher commodity prices and exchange rate pressures affected a large proportion of items across the CPI basket.

⁹ Following Nir et al. (2021), a dynamic factor model is used to estimate the common component based on 125 monthly ex-tax inflation series from January 1991 to June 2023.

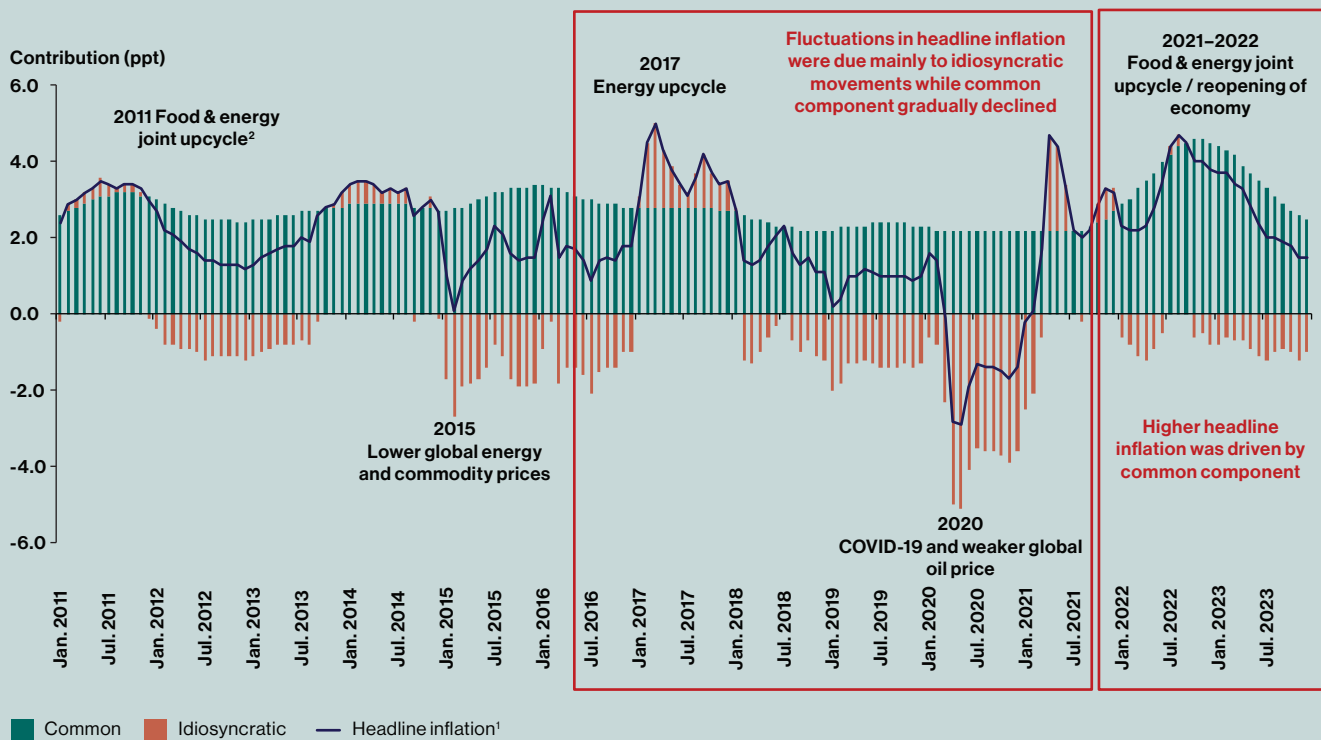
¹⁰ At the four-digit level of granularity, as published by Department of Statistics, Malaysia. The inflation of each individual item has been adjusted to exclude the direct impact of one-off changes in consumption tax policies (GST and SST) in 2015 and 2018.

¹¹ Common inflation is formally defined and calculated as the predicted series obtained from a simple linear regression of the monthly ex-tax headline inflation on an intercept and the common component derived from the dynamic factor model of CPI items.

¹² The concept of supercore inflation originated from the ECB, as published in a box article in ECB Economic Bulletin 2018.

¹³ While similar in concept, BNM's measure of supercore inflation differs in methodology from the ECB, which included items based on comparing the forecast error in a model containing output gap against a univariate autoregressive model.

Chart 6: Decomposition of Headline Inflation¹ by Common and Idiosyncratic Factors



¹ Headline inflation is adjusted to remove the changes in consumption tax policies (GST and SST) in 2015 and 2018.

² Upcycle refers to periods when global food and/or energy commodities exhibited year-on-year movements higher than the standard deviation. Global food and energy commodities data are from World Bank Commodity Price Data (The Pink Sheet).

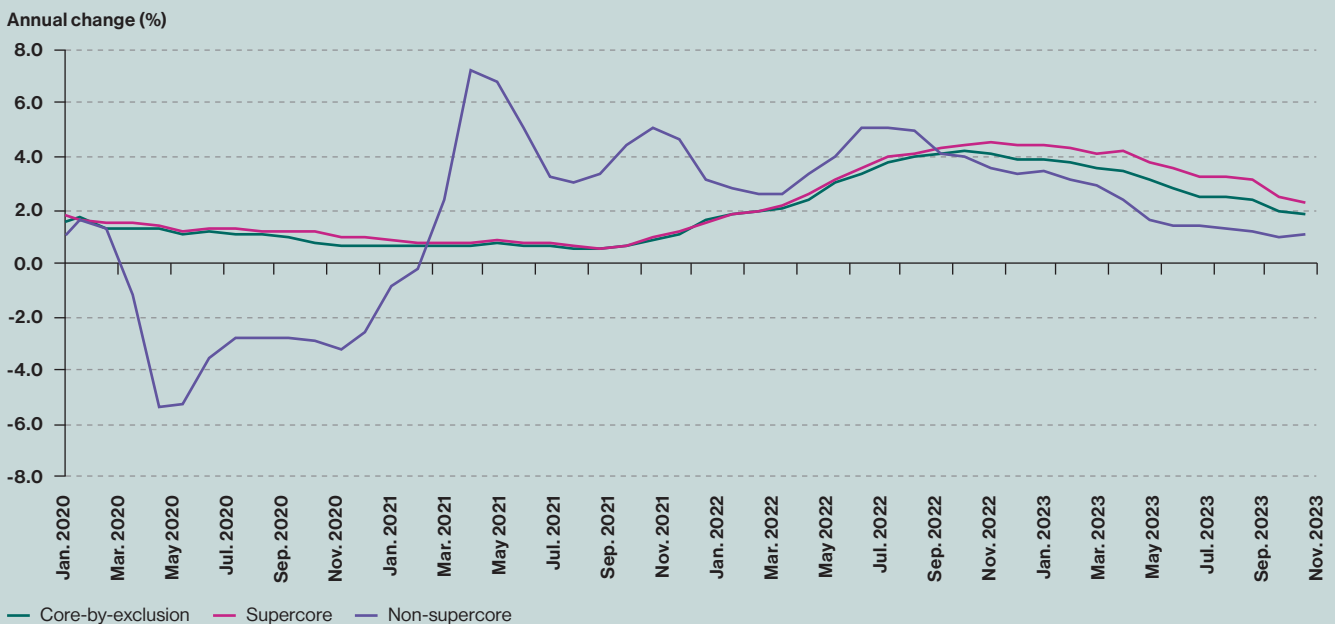
Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

Case study 4: Malaysia's experience following the post-pandemic reopening (2022–23)

Supercore inflation trended higher in 2021 driven by the rebound in demand pressures following the post-pandemic reopening of the economy.¹⁴ Domestic spending was further lifted by Government stimulus measures and Employees Provident Fund (EPF) special withdrawals. After peaking in February 2023, supercore inflation then showed a slower moderation compared to core-by-exclusion which began to ease after its peak in November 2022 (Chart 7). This trend indicates that the persistence of underlying inflation was partly driven by continued demand pressures in the economy, despite the downward pressure from easing global cost conditions which is reflected to a greater degree in the core-by-exclusion measure.

¹⁴ For more discussion on the rebound in demand pressures post-pandemic, please refer to the 2021BNM Economic and Monetary Review box article 'An Anatomy of Inflation: Effects from the Prolonged Pandemic'.

Chart 7: Supercore and Core-by-Exclusion Inflation



Source: Department of Statistics, Malaysia and Bank Negara Malaysia estimates

How did monetary policy respond to the signals from various underlying inflation measures?

Combining insights from the various measures of underlying inflation, we can see that robust domestic demand conditions, together with higher costs, played a role in driving higher inflation between 2022 and the first half of 2023. In particular, an uptrend was seen across all of the underlying inflation measures, as presented above, following the post-pandemic reopening of the economy. Moreover, this trend was seen across the CPI basket, rather than affecting just a small subset of items. This dynamic partly reflected the considerations faced by the Monetary Policy Committee (MPC). As the Malaysian economy was on a firmer footing following the COVID-19 crisis, the MPC gradually increased the Overnight Policy Rate (OPR) through five 25-basis point adjustments since May 2022, bringing the OPR to 3.00% in May 2023 from a historical low of 1.75% in 2020. The higher OPR helped to pre-emptively contain the risk of more excessive demand-driven price pressures amid the firm domestic economic recovery.

Since the second half of 2023, the underlying inflation measures had steadily declined, partly reflecting the disinflationary forces at play in line with global experiences, as well as the effect of the OPR adjustments. At the prevailing OPR level, the monetary policy stance was assessed to be consistent with the objective of sustainable economic growth amid price stability.

Conclusion

Measures of underlying inflation offer richer and more diverse perspectives that contribute to a greater understanding of price dynamics in Malaysia. Although the measures may diverge, investigating the reasons for deviations can reveal additional insights into the nature of price dynamics at hand. Coupled with deeper evaluations of broader macroeconomic conditions, this approach allows for a clearer signal of underlying inflation.

It becomes especially crucial to monitor underlying inflation during periods marked by significant and temporary fluctuations in highly volatile components, such as energy and food prices. This helps to gauge the broad direction of inflation in the medium-term. For monetary policy, underlying inflation measures ensure that central banks respond to signals of sustained shifts in the general price level, rather than temporary supply shocks. This ensures that monetary policy is calibrated in an appropriate and timely manner such that price stability in the medium-term horizon is achieved without placing undue pressure on economic activity.