Beyond the CPI: Producing analytical measures of inflation[1]

Leigh Merrington, Director Consumer Price Index, Australian Bureau of Statistics (ABS)

Abstract

Analytical measures of inflation provide important insights for policy makers, economists and the wider community to better understand inflation. The value of analytical measures were highlighted during two recent major events: the COVID-19 pandemic and the rapid rise in inflation experienced in many countries. Given their importance, little guidance or standards are available to help National Statistical Offices (NSOs) develop these measures. This has led to a lack of international comparability between countries producing analytical measures of inflation. This paper aims to address, or highlight, these issues and provide some guidance for producing these measures.

It is common for NSOs to use CPI output data to produce analytical measures of inflation. The ABS publishes a suite of analytical measures of inflation that have provided information for our users and are scrutinised as closely as the headline CPI. There are three broad purposes for analytical measures of inflation: insights into the trend or underlying nature of inflation; understanding the source or characteristics of inflation; and understanding how inflation affects different types of households. For the first purpose the ABS produces a trimmed mean and exclusion-based measures. For the second purpose we have decomposition measures that classify the CPI components into two sub-categories, such as Goods and Services or Tradables and Non-tradables. For the third purpose, the ABS produces inflation measures for four different types of households based on the main source of income (e.g. wages, pensions).

As part of the research for this paper, a short survey developed by the author was sent to NSOs to gather information on analytical measures of inflation. Results from the survey are presented which show the similarities and differences between what countries publish and how analytical measures are used.

This paper will describe the analytical measures of inflation produced by the ABS and explain their benefits for our users. A review of the existing literature on analytical measures of inflation is provided, as well as a summary of the measures produced by different countries. For countries thinking of producing their own analytical measures of inflation using the CPI output data, some considerations when designing these types of measures are covered in the paper.

Key words

Underlying inflation, analytical measures, trimmed mean, exclusion-based measures

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1. Introduction

The Consumer Price Index (CPI) is produced by most countries and is typically considered the pre-eminent measure of inflation. Inflation targeting has been adopted in several countries to manage monetary policy, with the CPI often used as the target measure of inflation. The CPI is also widely used for indexation purposes of government taxes and payments, as well as in negotiating private and public sector wages. This cements the CPI as a critical statistic for governments and central banks managing the economy, as well as informing the wider community of the health of the economy.

In addition to the CPI, National Statistical Offices (NSOs) traditionally use the CPI output data to produce analytical measures of inflation. These analytical measures complement the CPI and are designed to serve three broad purposes: insights into the trend or underlying nature of inflation; understanding the source or characteristics of inflation; and whether inflation has affected households in different ways.

The importance of analytical measures of inflation has been highlighted by two recent events that were experienced by most countries around the world: the COVID-19 pandemic in 2020 and the highest inflation in several decades from 2021-2023.

The shock caused by the pandemic had a large and unprecedented impact on the CPI and led to significant volatility in the monthly and annual CPI movements in many countries. Analytical measures provided important insights by removing or lessening the impact of temporary shocks to assess the rate of underlying inflation. These measures also assisted users understand the impact of the shock on the headline CPI and how to interpret what it meant for inflation.

The increase in inflation, which began in 2021, was unexpected by most policy makers and economists. Initially it was confined to inflation for goods that were traded internationally. This saw prices for goods increase due to supply chain issues combined with a surge in demand. Inflation then become more broad-based and spread to services products, resulting in the highest inflation for several decades. In many cases, analytical measures were able to capture these characteristics of inflation more closely than the headline CPI.

With the increasing importance of analytical measures, the lack of literature and research available on the design and performance of these measures is surprising. It also means there is a lack of consistency between NSOs on how to produce analytical measures, making international comparisons difficult. As part of the research for this paper, a short survey developed by the author was sent to NSOs to gather information on analytical measures of inflation published by different countries.

This paper will discuss these shortcomings and provide information that NSOs can use when reviewing their existing analytical measures of inflation or designing new measures. Sections in the paper cover the following: discusses the motivations of analytical measures; provides a summary of some of the literature and research available; explains the ABS's analytical measures and recent experience in Australia; presents the NSO survey results on the topic of analytical measures of inflation; and provides some considerations on the design and communication of these measures.

2. Why analytical measures of inflation are important

The CPI is often, but not always, regarded as the official measure of inflation. A challenge with measuring inflation is there is no single definition. Inflation is thought of as the rise in the general level of prices over time. A colloquial description of inflation is 'too many dollars chasing too few goods'. As an economic concept, it relies on the balance between supply and demand as the reason for higher or lower inflation. The Reserve Bank of Australia identifies three main causes of inflation: demand-pull, cost-push, and inflation expectations (RBA 2023).

The approach used to measure the CPI is the cost of a fixed basket, which enables the measurement of price change over time. The CPI basket includes all the goods and services purchased by households for consumption purposes. This means the CPI may be affected by events or decisions that result in price change not related to supply and demand. An example would be a change in taxes, such as the value added tax. The CPI is often impacted by large price increases that are unrelated to general economic conditions, such as a natural disaster causing a temporary shortage and higher prices of certain foods. The CPI also includes prices either set or subsidised by governments, particularly for health and education services, that again aren't impacted by supply and demand[2]. Therefore, there is a distinction between the economic concept of inflation and how it relates to supply and demand, and measured inflation, represented by the CPI[3].

It is common for NSOs to use the CPI output data to publish analytical measures that complement the CPI and which provide different insights into inflation. Three motivations for publishing analytical measures are: understanding underlying inflation; identifying the source or characteristics of inflation; and observing whether inflation is affecting particular types of households in different ways.

Measures that provide insights into underlying, core or trend inflation assist central banks, governments and financial markets on decisions in the short-medium term. Understanding underlying inflation is of particular interest for central banks that use inflation targeting. Removing (or lessening) the impact of one-off or temporary shocks that often impact the CPI provides insights into the persistence and trajectory of inflation. It can also highlight whether inflation is broad-based or being driven by a small number of products. The effects of monetary policy are considered lagged, therefore, central banks having a clearer understanding on the short-medium term rate of inflation is important for determining changes to interest rates. Measures of underlying inflation that are commonly published include 'CPI excluding food and energy' and 'Trimmed means'.

The CPI measures the price change of all the goods and services purchased by households. This makes it a broad measure of household inflation. Analytical measures help decompose or identify the main causes of inflation. This can provide insights into the source of inflation, such as whether it is imported or domestically driven, or whether it is due to higher prices in essential goods and services, which cannot easily be avoided. Knowing the source or characteristics of inflation help policy makers in their response to higher or lower inflation and how their decisions will impact inflation.

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[2] This is an example of 'non-economically significant prices'. The converse to this is 'economically significant prices', which are defined in the SNA08 as *"prices that have a significant effect on the amounts that producers are willing to supply and on the amounts purchasers wish to buy*".

[3] In Australia, the CPI is designed as a measure of inflation as the principal purpose. Many countries design their CPI for the purpose of measuring cost of living rather than inflation. In this case, there is no explicit attempt for the CPI to be a measure of inflation. However, it is still typical for the CPI to be used as a measure of inflation in these countries.

The CPI typically provides a measure of average inflation experienced by all households in a particular country. However, inflation can affect households in very different ways based on the demographics and characteristics of the households. This sees households with dissimilar consumption baskets having different inflation experiences. Measures of inflation can be published for households based on income, housing tenure, family dynamics, age and location. This could assist policy makers to understand which households are being most affected by inflation and what support to provide or policy changes to make. Knowing the different household experiences of inflation will enable governments to take a more targeted approach in their response to higher or lower inflation.

Producing a range of analytical measures provides insights into the different dimensions of inflation to assist policy makers, economists and financial markets. Section 4 of this paper showcases the analytical measures published by the ABS and the insights each measure provides.

3. Literature review

While literature on the CPI and how it's measured is plentiful, as evidenced by the Ottawa Group being in existence for 30 years, to the author's knowledge, there is far less literature or research available on analytical measures of inflation. This paper reviews the literature in two parts: international manuals and guidebooks available to NSOs; and research on underlying measures of inflation.

International manuals and guidebooks

The 2020 version of the IMF's international manual on CPI measurement runs to nearly 500 pages. However, details on analytical or 'alternative' measures are covered in less than a single page in paragraphs 14.23 to 14.26. The manual recognises that *"for the purpose of economic analysis, it is desirable to construct measures of core or 'underlying' inflation that exclude movements in the inflation rate that are attributable to transient factors… central banks use measures of the general trend of inflation when setting monetary policy, and for this reason, economists and statisticians are increasingly interested in developing measures of underlying inflation"* (IMF 2020, para. 14.23).[4]

The UNECE's 2009 'Practical Guide to Producing Consumer Price Indices' provides more detail on analytical measures of inflation covered over 11 pages in Chapter 11 titled 'Special Indices'. The Guide provides examples of these measures, some of the advantages and disadvantages and a few illustrative examples. The Guide notes that *"The ILO (International Labour Organization) Resolution says very little on the subject of special indices"* (UNECE 2009 para. 11.1) and acknowledges that *"although many countries publish 'core inflation' indices, there seems to be no clear definition of the term"* (para. 11.23). The purpose of analytical measures is explained by the Guide as to *"decompose or adjust the main CPI in order to shed light on aspects of inflation which may not otherwise be apparent"* (para. 11.7).

[4] A seasonally adjusted CPI is not discussed in this paper, although it could be considered an analytical measure. The IMF Manual covers it in paragraphs 14.11-14.16. It largely cautions against publishing seasonally adjusted measures of the CPI for reasons that seasonal adjustment is complex and seasonally adjusted data are subject to revision. This differs from most economic statistics where NSOs are encouraged to apply seasonal adjustment methods to provide a more informative measure of the monthly or quarterly movement.

The UNECE Guide summarises the considerations when publishing analytical measures: *"It is a matter for each country to decide which special indices to include with the release of the main CPI. Usually, resource availability and user needs will dictate which indices are published. All such indices should be treated as supplementary to the main CPI. It should also be noted that the publication of several CPI variants could be confusing to the public and potentially undermine credibility in the headline CPI unless provided with sufficient explanation to facilitate comparative analysis"* (para. 11.35).

The topics of underlying inflation and analytical measures were discussed at a session each at the 2009 Ottawa Group meeting and the 2006 UNECE meeting on Consumer Price Indices. With these meetings held every two years, it is surprising the topic hasn't been given more attention at these forums for measures that are valuable in understanding the trend or characteristics of inflation.

COICOP 2018 provides guidance on which products are considered 'goods' and 'services'. A SNA08 definition is used to further classify goods as either 'durable', 'semi-durable' or 'non-durable'. COICOP 2018 acknowledges the difficulties of classifying some products as a good or service, such as restaurant meals, and in these cases classifies the product as a service. To demonstrate the value of international standards being available for NSOs, the survey results in section 5 of this paper show that publishing analytical measures of 'Goods inflation' and 'Services inflation' is one of the most common practices by NSOs.

Missing from the IMF Manual and UNECE Guide, which are designed to guide and inform NSOs on how to produce the CPI and disseminate their data, are definitions and standards for NSOs to align and aspire to. While it is true that every country is different and has different user needs, being able to refer to international standards is extremely valuable in developing trusted statistics. Definitions, such as how to classify tradable and non-tradable products, or essential and discretionary products, would encourage NSOs to produce these measures and support international comparability. Countries interested in understanding core or underlying inflation would benefit from knowing the advantages and disadvantages of different exclusion-based or trimmed mean measures. Providing advice and guidance on these measures would help create a standard that can be used for international comparisons.

Research on underlying measures of inflation

Further literature is available on underlying, or 'core' inflation that is usually specific to a particular country. It is useful to learn about the experience of other countries in producing these measures, however some aspects may be unique to the country. The author found very little literature available on measures which decompose the CPI into sub-components, although Griffiths (2009) covers it in some detail for New Zealand. The rest of the literature review focuses on measures of underlying inflation.

As stated in the UNECE Guide of there being an absence of a definition of underlying inflation, a definition is given in Roberts (2005) *"underlying inflation, also known as 'core' inflation, can be regarded as the medium-term trend in inflation. That is, it is the inflation rate that would be recorded if one were to abstract from (or down-weight) sharp, quickly reversed movements in prices or one-off shocks that create short-term volatility in measured inflation"*. This is a fairly intuitive way to describe underlying inflation as being a measure that is less volatile than the CPI but also provides information on the rate and trajectory of inflation.

To assist in designing measures of underlying inflation, Roberts (2005) outlines a simple criteria of desirable properties, *"a good measure of underlying inflation should be less volatile than CPI inflation, be*

unbiased with respect to CPI inflation, and capture the 'trend' in CPI inflation so that, on average, CPI inflation will tend to adjust towards the measure of underlying inflation". The criteria is helpful to assess the performance of various measures of underlying inflation against each other and against the CPI.

Other desirable properties for measures of underlying inflation mentioned in Griffiths (2009) and Biggeri *et. al.* (2009) are they should be simple, timely, credible and verifiable.

Findings from Roberts (2005) favoured a trimmed mean approach over exclusion-based measures to measuring underlying inflation: *"By removing elements from the distribution of price changes on a time-varying basis (rather than applying a fixed rule for all periods), trimmed means or weighted medians exploit the trade-off between efficiency and robustness better than some other core inflation measures. Moreover, they are relatively intuitive, making them easy to interpret in practice".*

To ensure the measure of underlying inflation is trusted, Silver (2006) described some of the principles in the design of the measure, where it's being produced by a central bank: *"The public should not be under the impression that the measure chosen has been selected on the basis that it is likely to guarantee favourable results. The measure should be clearly defined and reproducible, changed as infrequently as possible, and should be produced, or at least derived, from a CPI produced by an independent statistical authority".*

In determining between the choice of exclusion-based measures and a trimmed mean approach, Silver (2006) suggests the decision *"should be data driven, so that the methods adopted…can be justified on an objective, transparent basis"*.

While there is no clear choice between the different measures, the literature is fairly consistent on the advantages and disadvantages between the two approaches, which are summarised in the following table.

Approach	Advantages	Disadvantages
Exclusion-based measures	• Simple to produce and explain • Comparing the same basket each period	• Arbitrary choice of what to exclude • Products excluded may be considered important • Misses general inflation of what's excluded • Includes impact of shocks in other products • Products may become more or less volatile over time
Trimmed mean or weighted median	• More dynamic in lessoning impact of outliers • Objective choice of what's excluded each period	• More complex to produce • Comparing different baskets each period • Decision needed on how much to trim/exclude

One other disadvantage of a trimmed mean discussed by Silver (2006) was that if a shock causes a sudden large price rise and then a slow return to the normal price, a trimmed mean will exclude the large price rise and include the subsequent smaller price falls. This asymmetry would lead to a downward bias in the trimmed mean when compared to the CPI.

A potential bias in the weighted median is explained by Griffiths (2009) where "*the distribution of price movements is positively skewed, the weighted median movement will tend to lie below the CPI movement. Where the distribution of price movements is negatively skewed, the weighted median movement will tend to lie above the CPI movement".*

These advantages and disadvantages need to be considered in the choice of approach and design of the measure of underlying inflation. The literature is clear on the importance of transparency of the choice of approach and suggests explaining the methods to users and publishing research on the performance of the different measures.

4. ABS underlying inflation and analytical measures

Measures of underlying inflation

It is common practice for NSOs to publish data that give a sense of underlying inflation, also referred to as 'core' or 'trend' inflation. These measures are designed to remove the volatility often observed in the monthly and annual CPI movements and are typically published in a table or chart alongside the CPI.

The most common approach is an exclusion-based measure where food and energy (or some variation of this) are removed from the CPI basket and is published as an alternative series. In Australia, exclusion-based measures are published, however a Trimmed mean is considered the principal measure of underlying inflation, while a Weighted median is also published.

For the Trimmed mean published by the ABS, a symmetric trim is used. The Trimmed mean is calculated using a weighted arithmetic mean of the quarterly movements from the middle 70% of the distribution. The Expenditure Classes (ECs) with the lowest quarterly[5] movements for 15% of the weight of the CPI basket are removed, as are the ECs with the highest quarterly movements for 15% of the weight of the CPI basket. The Weighted median is simply the quarterly movement of the EC at the 50th percentile in the distribution. Chart 1 provides an illustration of how the Trimmed mean is produced.

Importantly, the quarterly movements used in the calculation of the Trimmed mean are seasonally adjusted. This is because where prices are affected by calendar related events or weather conditions, as in the case for fruit and vegetables, the quarterly movements in original terms can be quite volatile. By taking seasonality into account, these ECs are not always excluded from the Trimmed mean and any underlying inflation for these ECs is captured.

[5] Australia currently publishes the CPI quarterly. ABS work is underway to produce a complete monthly CPI in late 2025.

Chart 1: Trimmed mean illustration

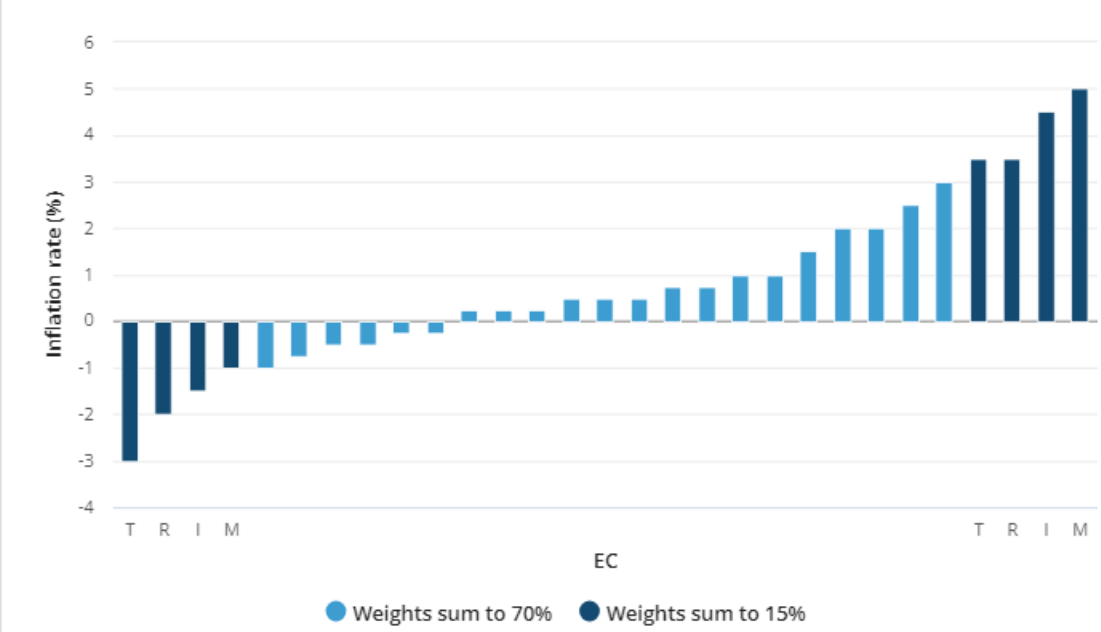
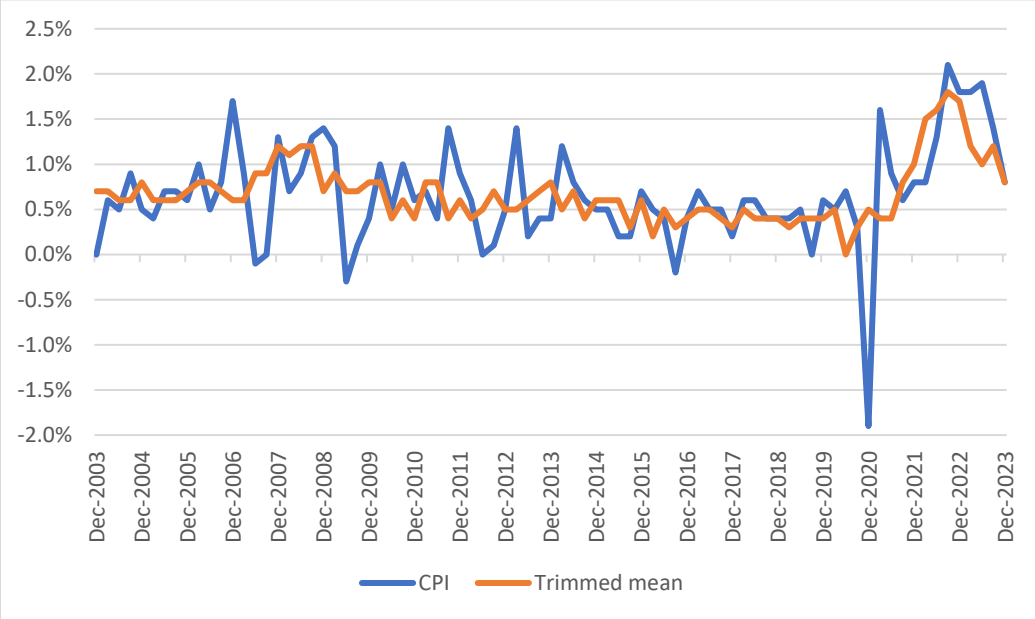


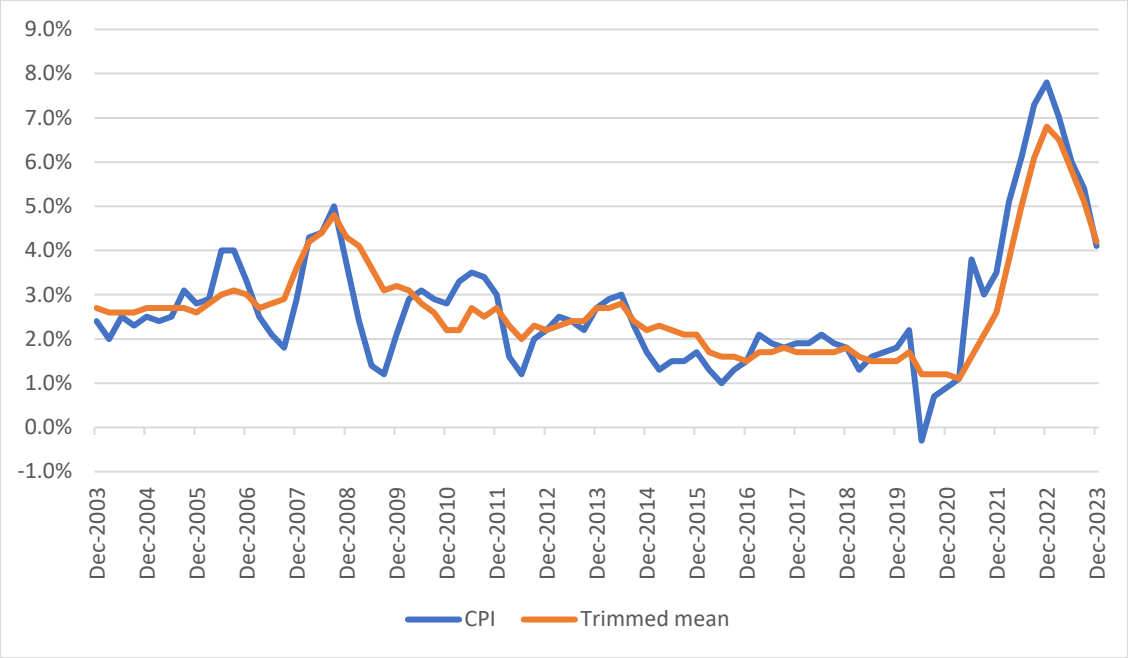
Chart 2 compares the CPI quarterly movements and the Trimmed mean quarterly movements. The Trimmed mean is clearly smoother than the CPI and performs well in showing the trend of inflation. A good example of this is in June 2020 quarter at the onset of the COVID-19 pandemic. The CPI had a record quarterly fall of 1.9%, which was largely due to a 19% fall in automotive fuel prices and child-care being temporarily made free (95% fall). The Trimmed mean removed these two impacts and showed no movement (0.0%) for the quarter. When normal prices returned in the following quarter for automotive fuel and child-care, the CPI had a quarterly rise of 1.6%, compared to the Trimmed mean's rise of 0.3%. Removing the temporary shocks of automotive fuel prices and free child-care illustrates how the Trimmed mean was effective showing the trend of inflation during this period.

Chart 2: CPI & Trimmed mean, quarterly movements (%)



With inflation usually discussed in annual terms, it's important to assess the volatility of movements over a 12-month period. Chart 3 compares the annual movements of the CPI and Trimmed mean, where the Trimmed mean is again clearly smoother than the CPI.

Chart 3: CPI & Trimmed mean, annual movements (%)



It is useful to undertake a more objective assessment of the performance of the Trimmed mean against the criteria described in Roberts (2005): a measure of underlying inflation should be both unbiased and less volatile when compared to the CPI. Looking at the quarterly average movement over a 20-year period in table 1, the Trimmed mean is the same as the CPI. Other measures published by the ABS show a small bias when compared to the CPI. The standard deviation is used to determine volatility (or variability) of the quarterly movements. The Trimmed mean's standard deviation is significantly below the CPI's and also below the two exclusion-based measures.

Based on this simple criteria, the Trimmed mean performs best as a measure of underlying inflation. Another advantage is the Trimmed mean is relatively easy to explain and is able to be reproduced by users, however this also applies to the other measures included in table 1.

Table 1. Comparison of bias and variability of underlying inflation measures, 2003-2023

	CPI	Trimmed mean	Weighted median	CPI ex. food & energy	CPI ex. volatile items[6]
Average quarterly movement	0.67%	0.67%	0.69%	0.64%	0.66%
Standard deviation	0.56%	0.33%	0.32%	0.44%	0.44%

[6] Volatile items are fruit and vegetables and automotive fuel.

Analytical measures of inflation

The next part discusses two prominent measures published by the ABS that provide insights into the source or characteristics of inflation: Tradable and Non-tradable products; and Non-discretionary and Discretionary products. These are also known as decomposition measures as it decomposes the movement in the overall CPI into separate components. The approach used by the ABS divides the CPI into two mutually exclusive sub-baskets and classifies each of the 87 Expenditure Classes (EC) to one of the sub-baskets.

Judgement is often required to determine which sub-basket to classify each EC to. This paper has already made the point that having international standards and definitions would assist NSOs in developing their own analytical measures and support international comparisons. It would be greatly beneficial if there were standards on how to classify a product as discretionary or non-discretionary, for example, as it is often down to judgment rather than an evidenced based decision.

Also discussed are how these analytical measures provided different insights during two recent major events: the COVID-19 pandemic and the highest inflation in Australia in over 30 years. CPI inflation in Australia peaked at 7.8% in December 2022, which led to the central bank's cash rate rising from 0.1% in 2021 to 4.35% in late 2023. Higher inflation also generated significant media interest on how it was affecting the cost of living in Australia.

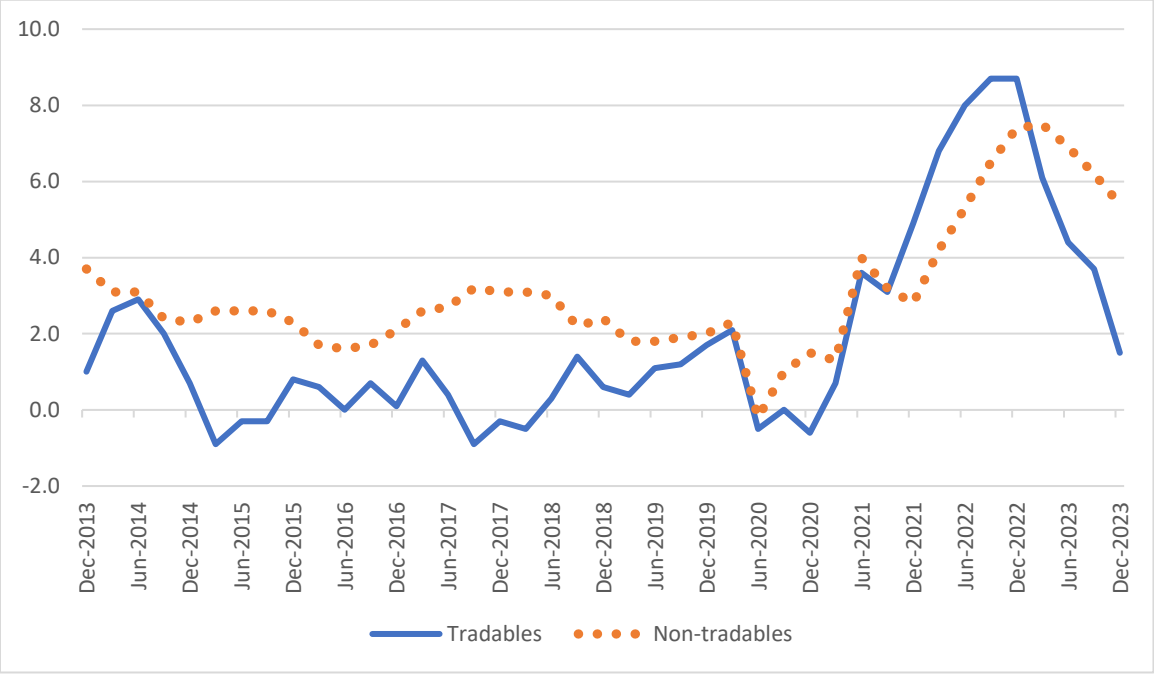
Tradables and Non-tradables inflation

The Tradables and Non–tradables series measures the contribution of products that are highly exposed to international trade influences (tradables), and those that are mostly influenced by domestic factors (non–tradables), to overall CPI inflation. This provides an insight into the source of inflation and whether it's domestically driven, such as by wages growth or a change in taxes, or due more to international factors such as higher import prices and shipping costs or changes in the exchange rate. Tradables contributes 35% to the overall CPI and Non-tradables contributes 65%.

To determine whether a product was classified as Tradable or Non-tradable, the level of imports and exports as a proportion to Australian production was used as a guide. This was a useful starting point, but there were a number of exceptions to this approach. A notable exception is Tobacco. Cigarettes are not manufactured in Australia and is an entirely imported product, however, the main cause of price change is due to domestic taxes. Therefore, the Tobacco EC has been classified as a Non-tradable. This highlights an important point that products aren't being classified based on the contribution to the price, rather whether the change in the price is driven by national or international factors.

Chart 4 compares the annual inflation of Tradables and Non-tradables. During the COVID-19 pandemic there was deflation for Tradables, largely due to the fall in automotive fuel prices. Tradables inflation rose quickly throughout 2021 and 2022 and peaked at 8.7% in the second half of 2022 as automotive fuel prices rose along with strong demand and constrained supply of imported goods such as furniture, household appliances and motor vehicles. Tradables inflation has since eased significantly and sits well below Non-tradables inflation in December 2023.

Chart 4: Tradables and Non-tradables inflation, annual movements (%)



Discretionary and Non-discretionary inflation

A relatively new measure published by the ABS is Discretionary and Non-discretionary (Essential) inflation. These measures help assess whether there is excess demand in the economy, reflected by rising prices for discretionary products, and the cost-of-living experience of households, represented by inflation for non-discretionary products.

Deciding whether a good or service meets a basic need (non-discretionary) is subjective and will differ across households. The ABS applied the following definitions when classifying each of the 87 ECs:

- Non-discretionary - products which are purchased because they meet a basic need (food, shelter, healthcare), are required to maintain current living arrangements (car maintenance, school fees), or are a legal obligation (compulsory insurance, stamp duty). Spending on these products may be less responsive when there are changes in household wealth and incomes, or changes in relative prices.
- Discretionary - products which did not meet the non-discretionary criteria and are thought of as 'optional' purchases, includes take-away meals, alcohol and holiday travel. Spending on these products may be more responsive to changes in household wealth and incomes, or changes in relative prices.

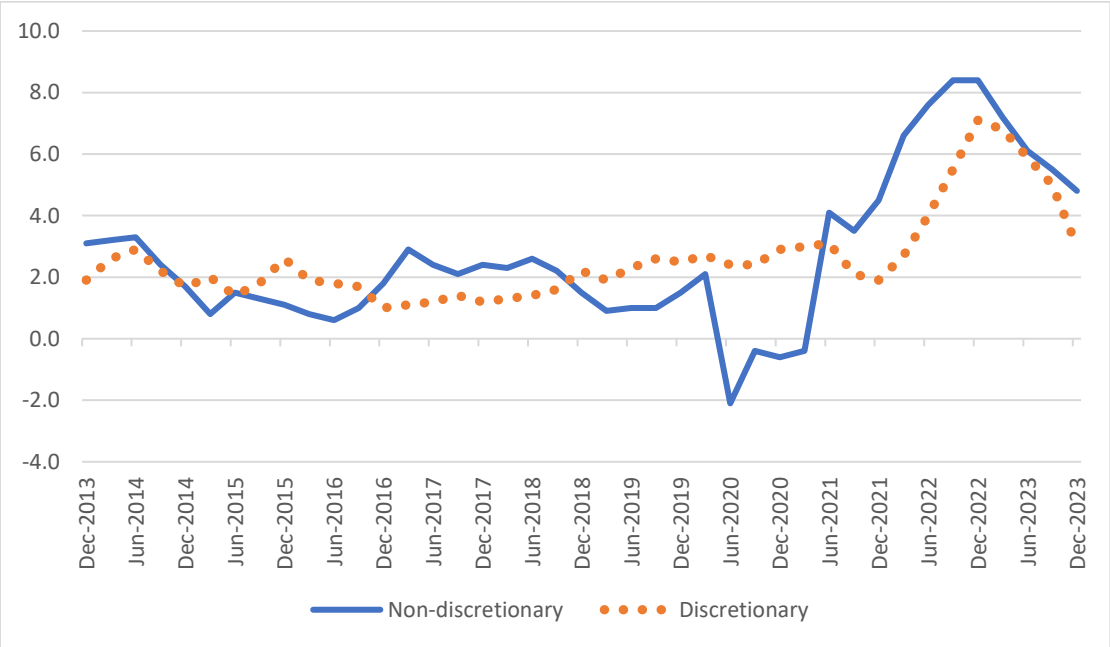
Another approach would be to classify products based on the elasticity of demand. If the product is elastic, it can be considered discretionary, if it is inelastic, it is non-discretionary. Measures of elasticity of demand are not readily available, so judgement was required to classify each of the 87 ECs.

Noting the subjectivity of classifying products as discretionary or non-discretionary, the ABS published a consultation paper of the definitions and classification and provided analysis of the two series in ABS (2021). The paper sought feedback from users on the approach, with users largely agreeing with the ABS's classification and welcoming the new measures.

Discretionary products contribute 40% to the overall CPI and Non-discretionary products contribute 60%.

Chart 5 shows that during the COVID-19 pandemic, non-discretionary products recorded annual deflation for several quarters due to lower automotive fuel prices and child-care being temporarily free. For the high inflation period that followed over the next two years, Non-discretionary inflation has been higher than Discretionary inflation. This has been driven by strong price rises for food, new dwelling construction, utilities, automotive fuel, rents and insurance. These products are often referred to by policy makes and the media in discussions of cost-of-living pressures, so it is helpful having a measure which combine these essential products into a single measure of inflation.

Chart 5: Discretionary and Non-discretionary inflation, annual movements (%)



Inflation measures for different households

Understanding how inflation, or cost of living, affects households differently can provide an important insight for policy makers. It's well known that households' consumption baskets vary greatly depending on age, income, location, family status, housing tenure and many other factors. The CPI is designed to provide a measure of average inflation experienced by all households and does not capture the experience of different types of households.

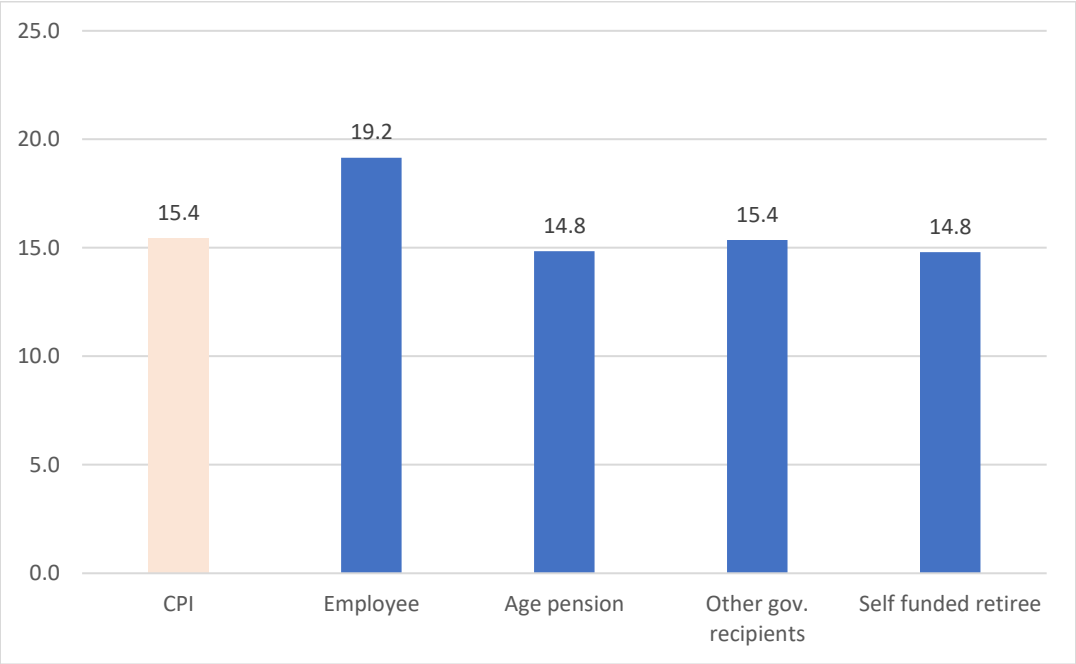
In addition to the CPI, the ABS publishes 'Living Cost Indexes (LCIs)' for four different types of households based on their main source of income: Employee, Age pensioner, Other government transfer recipients and Self-funded retirees[7]. The LCIs are produced by creating a different set of weights for each type of household and applying the CPI movements at the detailed Expenditure Class level. The different weights result in quarterly movements that differ at the aggregate level for each household type.

[7] This paper does not cover the conceptual and measurement differences between the CPI and Living Cost Indexes. The main difference is Owner Occupied Housing, which is measured by dwelling construction costs in the CPI and mortgage interest charges in the Living Cost Indexes. For more information see Selected Living Cost Indexes.

To produce the weights for each household type, data is used from the ABS's Household Income and Expenditure Survey. For the household types measured by the ABS, the weights can vary by a significant amount. For example, Education has a weight of 4.5% for Employee households and only 0.2% for Age pensioner households. The weight for Health is 6.2% for Employee households and nearly 12% for Age pensioner and Self-funded retiree households.

Looking at the period of higher inflation over the past three years shows the LCI for Employee households has increased the most at 19.2%. The main reason for this is due to the higher weight for mortgage interest charges, which has increased 113% over the past three years. The other three households have experienced a relatively similar increase in living costs of around 15% and close to CPI inflation of 15.4%.

Chart 6: Cumulative inflation by household type, 2021-2023 (%)

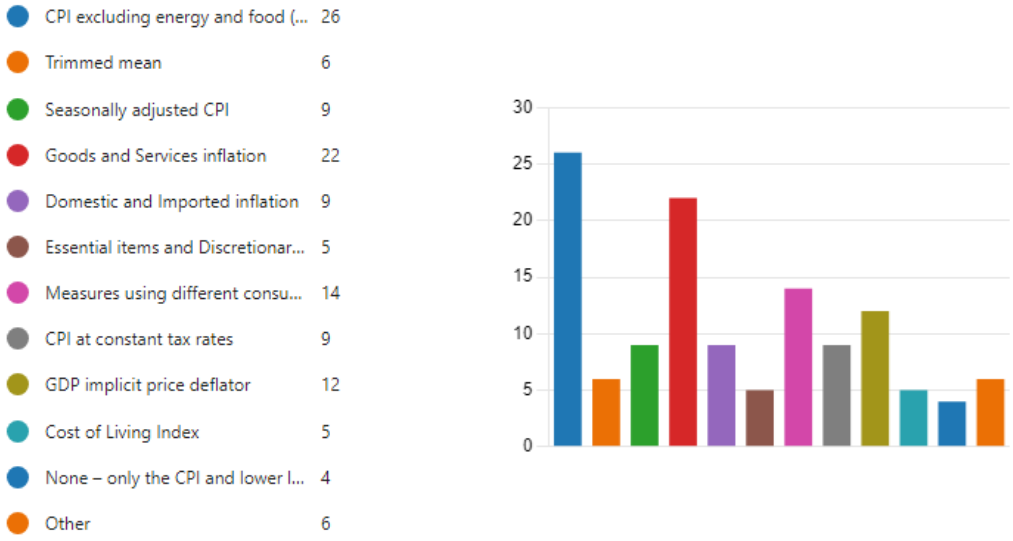


5. NSO survey results

As part of the research for this paper, a short survey was sent to NSOs to gather information on analytical measures of inflation. The survey asked what sort of analytical measures they published, how prominent they are and how they are used. Details of the survey are provided in appendix 1 and country specific responses are provided in appendix 2. There were 32 responses received from NSOs and 2 from Central Banks representing a diverse mix of countries.

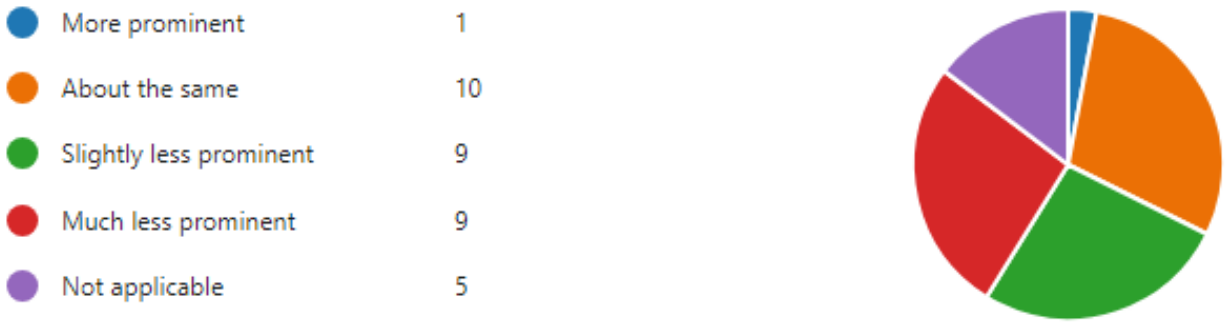
Chart 7 shows the most common analytical measures produced are CPI exclusion-based measures and Goods and Services inflation. For the measures published by the ABS discussed in this paper, only a small number of NSOs publish a Trimmed mean measure of underlying inflation and Essential and Discretionary inflation measures. A few more NSOs published measures of Domestic and Imported inflation, Implicit Price Deflators and measures for different household types.

Chart 7: Response to question 'Does the NSO also publish any of the following analytical measures?'[8]



NSOs were asked how prominent the analytical measures were, with about two-thirds responding that the analytical measures are as prominent or slightly less prominent compared to the CPI, with one response that they were more prominent than the CPI. This suggests that the information provided by analytical measures complements, rather than replaces the CPI as the principal measure of inflation. These measures enhance the understanding of inflation for users such as Central Banks, governments, financial markets, economists and the media.

Chart 8: Response to question 'How prominent are these measures compared to the CPI?'



[8] Some countries selected they publish a Cost of Living Index (COLI), however there may have been some confusion about the definition of a COLI and what was being asked in the survey. The intent of the question was to see whether NSOs produce a conditional COLI, which is typically a superlative index such as a Fisher or Törnqvist index. A follow up with some of these NSOs indicated that the selection of publishing a COLI was an alternative measure using the Outlays approach, similar to Australia's Living Cost Indexes discussed in this paper. While not technically a COLI, these measures are considered a closer approximation of cost of living than the CPI.

Chart 9 indicates that analytical measures have many uses, with the most common being for inflation targeting and insights into underlying inflation. What's not clear is whether the analytical measures are used to inform inflation targeting or is the actual measure used by the Central Bank as its inflation target. Interestingly, several NSOs responded saying these measures are used for indexation and deflation, which shows they are used for more than just analytical purposes. The response also shows how prominent analytical measures are in the media and are an important source of information for communicating to the wider public.

Chart 9: Response to question 'Are any of the analytical measures used for the following purposes?'

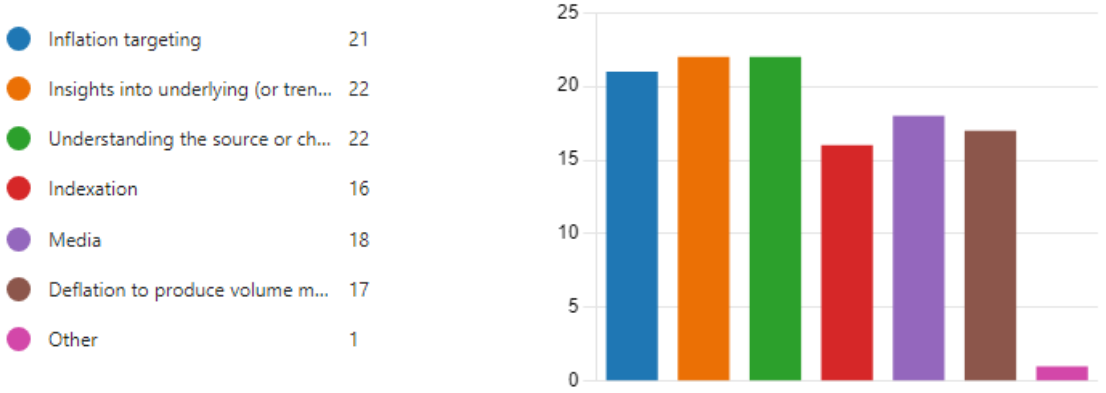
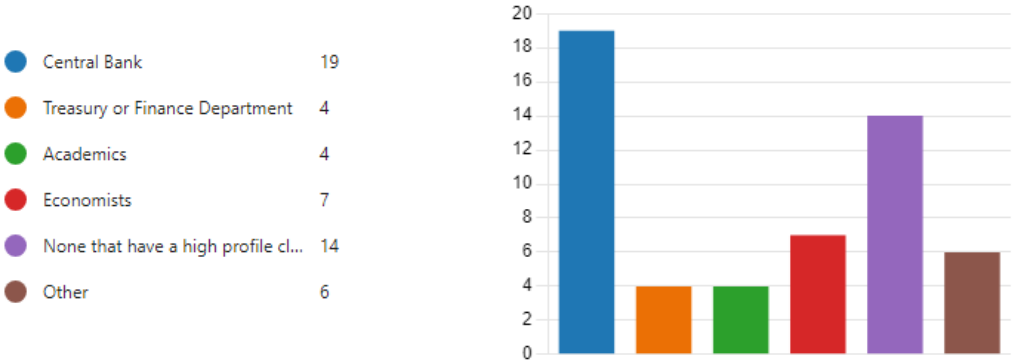


Chart 10 shows over half of NSOs responded saying there are no other analytical measures of inflation produced by other institutions. For those that responded that there were, it was common for the Central Bank to produce analytical measures. This is a reminder that producing economic statistics is a contested space. NSOs should be mindful of this to ensure their place as the principal agency producing trusted and independent statistics is maintained and not to be taken for granted.

An example of this was prior to 2010, the Reserve Bank of Australia (RBA) used to publish the Trimmed mean shortly after the CPI was published. The ABS has since taken over the production of the Trimmed mean and publishes it at the same time as the CPI. While the Trimmed mean method was developed by the RBA, the ABS is now considered the owner of the Trimmed mean and is responsible for its quality, including the seasonal adjustment process and updating of weights.

The US is an interesting case where there is a decentralised statistical system, with more than one NSO. The Bureau of Labor Statistics is responsible for producing the monthly CPI, while the Bureau of Economic Analysis produces the GDP Implicit Price Deflator and an alternative inflation measure known as the Personal Consumption Expenditure (PCE) Price Index. The PCE Price Index is used by the Federal Reserve as the preferred inflation measure for monetary policy purposes. This is an example of a measure other than the CPI being used as the inflation target.

Chart 10: Response to question ': Do any other institutions publish analytical measures using the CPI outputs?'



6. Designing analytical measures of inflation

The first thing to consider when designing analytical measures of inflation is knowing what the question is you are trying to answer. Having a clear idea of the purpose or question being answered is important for the design of the analytical measure[9]. The following table includes some common questions and possible measures that provide insights into these questions.

Question	Analytical measure
What is the impact of wages growth on CPI inflation?	Splitting the CPI into Goods and Services baskets
What is the source of inflation – domestic or international factors?	Splitting the CPI into Tradable and Non-tradable baskets
What is the cost-of-living experience for households?	Splitting the CPI into Discretionary and Essential baskets or a superlative (Fisher) index
How is inflation affecting low income households?	Inflation measures that use weights by income quintile
What is the trend of inflation?	Trimmed mean or CPI excluding volatile products
What would have been the CPI movement without the impact of oil prices?	CPI excluding automotive fuel
What is the CPI movement taking into account calendar related events?	CPI seasonally adjusted
What would have been the CPI movement without a change in taxes?	CPI at constant taxes

If the type of measure being produced is splitting the CPI into two baskets, it's important to provide definitions for each of the sub-baskets. Preferably this would be based on well-established definitions used in the CPI or other statistics, such as the System of National Accounts. Efforts should be made to align the sub-baskets to these definitions, however in some cases it is not always a clear-cut decision. In

[9] This is also true for the design of the CPI and its principal purpose. This will determine the choice of approach used between Acquisitions, Outlays or Cost of Use.

these cases, it is reasonable to categorise the CPI component based on which sub-basket the majority of expenditure aligns to. If expenditure data is not available, judgement may be used and the reasons should be communicated. The two sub-baskets should be published and users given the opportunity to provide feedback on the definitions and classification.

For other measures such as a Trimmed mean or CPI exclusion-based measures, the method should be simple for users to understand. Comparing these measures with each other and alongside the CPI is important to assess whether there is a bias or lag in the analytical measure, and whether the volatility of the movements is more or less compared to the CPI movements. Publishing these findings will provide transparency and ensure the measures are trusted by users.

As discussed in the literature review, what measure of underlying inflation to publish, such as different types of trimmed means and medians and exclusion-based measures, is not a straightforward choice. What can be helpful is publishing two or more measures of underlying inflation which give similar results. This avoids a choice having to be made and can enhance the credibility of these measures. Of course, if the two measures differ at times it can undermine their credibility. The ABS publishes two measures of underlying inflation: a Trimmed mean and Weighted median. Typically, these two measures produce similar results, however the Trimmed mean has more prominence and is regarded as the official measure of underlying inflation in Australia.

For all analytical measures, it's good practice to use published data in their design. This ensures transparency and enables users to re-produce these measures themselves. Again, this will create a level of trust in the analytical measures and enhance their credibility.

Also important for the credibility of analytical measures is publishing them on a consistent basis (i.e. every month) as a time series. This demonstrates the measures are a valuable source of information. In saying that, it's also important to be responsive to events and publish analytical measures on an ad hoc basis.

An example of when the ABS did this was when child-care became temporarily free in 2020 where a quarterly movement of 'CPI excluding child-care' was published in the CPI release. In June 2020, the CPI had a record quarterly fall of 1.9%. Excluding the effects of free child-care, the quarterly movement was a smaller fall of 0.8%. Publishing this information assisted users in understanding the impact of free child-care on the CPI.[10] This was repeated the following quarter when child-care was no longer free, which saw the CPI movement rebound with a quarterly rise of 1.6%, compared to a 0.7% rise when excluding child-care. Feedback from users welcomed these 'ad-hoc' exclusion-based measures, which the ABS has since repeated for other cost-of-living relief policies, such as those seen for electricity and rents.

When publishing the analytical measures, thought needs to be given on how prominent to make them compared to the CPI. In Australia, the analytical measures are nearly as prominent as the CPI for our key users including the Central Bank, governments, economists, financial markets and journalists. The ABS prioritises the CPI movement in its media release and publication commentary. However, the analytical measures are regularly highlighted and graphed alongside the CPI where they provide an insight into CPI inflation[11]. Data for the analytical series are easily accessible and available at the same time as the CPI is

[10] For more details see June quarter 2020 CPI exclusion-based measures
[11] Example of ABS media release and publication commentary.

published. An exception to this is the ABS's Living Cost Indexes, which are published separately one week after the CPI[12].

If the NSO is not in a position to publish analytical measures of inflation, perhaps due to lack of staffing or IT resources, the NSO should assist other institutions or stakeholders to produce these measures. This would include: publishing the CPI price and weighting data at a detailed enough level to enable the decomposition of the CPI; providing methodological support and peer review; and ensuring the correct use of the CPI data. This will help strengthen the relationship between the NSO and users of the CPI, while providing valuable insights into inflation.

7. Conclusion

Analytical measures of inflation are relatively simple to produce using outputs from the CPI. These measures provide valuable insights into the trend and characteristics of inflation. NSOs typically publish one or more analytical measures using variations of the same concepts and methods. NSOs recognise the importance of these measures to complement the CPI, and in some cases, are used as the preferred measure for inflation targeting and for indexation and deflation purposes. The measures are also covered extensively by the media to communicate the CPI and explain any change in the rate of inflation.

The ABS produces a range of analytical measures of inflation that serve the purpose of answering a particular question to better understand inflation or provide insights into the trend and trajectory of inflation. These measures receive a significant amount of attention from the central bank, government, economists, financial markets and the media. NSOs that responded to the survey showed a similar level of importance and interest in analytical measures in other countries.

What is missing, and perhaps results in fewer NSOs publishing analytical measures of inflation, are international standards that would help guide NSOs in their design and support international comparability. National Accounts statisticians provide a useful template to follow where the System of National Accounts 2008 has a chapter on 'Satellite accounts and other extensions'. Similarly, efforts have been made by the OECD and others to develop standards on emerging themes such as measuring the digital economy.

Evidence of the value of international standards is shown through two of the most common analytical measures produced, which are Goods and Services inflation and CPI excluding food and energy. In the case of the former, COICOP 2018 provides a well-established standard of classifying products as Goods or Services. For the latter, there is consistency across countries that food and energy have volatile prices and it is helpful to exclude their impact to produce a smoother series to measure underlying inflation.

By showcasing the ABS's analytical measures of inflation, it is hoped this paper encourages NSOs to produce similar measures of their own. The paper provides considerations in the design and publication of analytical measures that provide some guidance to lead to greater consistency across countries.

Finally, this paper aims to begin a conversation amongst the Prices international community towards making efforts to develop standards and guidelines for NSOs to adhere to when producing analytical measures of inflation.

[12] See the ABS's Selected Living Cost Indexes

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Appendix 1: Survey sent to NSOs

Please state which country this response is for.

Question 1: Do you work at the National Statistical Office (NSO)?

- Yes
- No – another institution

Question 2: In addition to the CPI, does the NSO also publish any of the following analytical measures? (choose all that apply)

- CPI excluding energy and food (or a similar version to this)
- Trimmed mean
- Seasonally adjusted CPI
- Goods and Services inflation
- Domestic and Imported inflation
- Essential items and Discretionary items inflation
- Measures using different consumption baskets (weights) or for different types of households
- CPI at constant tax rates
- Cost of living index
- GDP implicit price deflator
- Other, please state
- None – only the CPI and lower level components produced

Question 3: If publishing analytical measures, how prominent are these measures compared to the CPI? (choose most applicable)

- More prominent
- About the same
- Slightly less prominent
- Much less prominent
- Not applicable

Question 4: Are any of the analytical measures used for the following purposes? (choose all that apply)

- Inflation targeting
- Insights into underlying (or trend) inflation
- Understanding the source or characteristics of inflation
- Indexation
- Media
- Deflation to produce volume measures in the National Accounts
- Other, please state

Question 5: Do any other institutions publish analytical measures using the CPI outputs that have a high profile for inflation measurement? (choose all that apply)

- Central Bank
- Treasury or Finance Department
- Academics
- Economists
- Other
- None that have a high profile close to the CPI

Question 6: Are you happy for your country's response to be identified in the paper or would you like it to be kept confidential?

- Happy to be identified
- Keep confidential

Please provide additional details to any of your responses or links to relevant information

Appendix 2: Country results of the survey

Some NSOs requested their responses be kept confidential. These countries have not been included in the following report.

In addition to the CPI, does the NSO also publish any of the following analytical measures?

	AUS	AUT	ARM	BLZ	CAN	CHE	EAC	ESP	ETH	FRA	GBR	GEO	IDN	ITA	JPN	LUX	MEX	NLD	NOR	NZL	TJK	USA	ZAF
CPI excluding series	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Trimmed mean	✓				✓						✓								✓	✓			✓
Seasonally adjusted	✓				✓					✓					✓				✓	✓		✓	
Goods and Services	✓		✓		✓	✓	✓			✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓
Domestic and Imported	✓					✓	✓					✓		✓					✓	✓			
Essential and Discretionary	✓	✓													✓		✓						
Different households	✓						✓			✓	✓			✓	✓	✓				✓		✓	✓
CPI at constant tax		✓			✓			✓		✓	✓				✓			✓	✓				
GDP IPD	✓	✓		✓	✓			✓		✓			✓	✓			✓	✓	✓	✓			
Cost of living											✓									✓			
Other													✓									✓	✓
None									✓														

How prominent are these measures compared to the CPI?

	AUS	AUT	ARM	BLZ	CAN	CHE	EAC	ESP	ETH	FRA	GBR	GEO	IDN	ITA	JPN	LUX	MEX	NLD	NOR	NZL	TJK	USA	ZAF
More prominent															✓								
About the same			✓		✓		✓						✓						✓		✓		
Slightly less prominent	✓			✓		✓					✓	✓						✓		✓		✓	
Much less prominent		✓						✓		✓				✓		✓							✓

Are any of the analytical measures used for the following purposes?

	AUS	AUT	ARM	BLZ	CAN	CHE	EAC	ESP	ETH	FRA	GBR	GEO	IDN	ITA	JPN	LUX	MEX	NLD	NOR	NZL	TJK	USA	ZAF
Inflation targeting			✓	✓	✓	✓	✓					✓	✓	✓	✓			✓	✓	✓	✓		✓
Underlying inflation	✓				✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓
Source of inflation	✓				✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓
Indexation				✓			✓			✓		✓		✓				✓	✓	✓	✓	✓	✓
Media	✓	✓	✓		✓	✓	✓				✓	✓						✓	✓	✓			
Deflation	✓	✓	✓	✓	✓		✓			✓		✓		✓			✓	✓	✓	✓			

Do any other institutions publish analytical measures using the CPI outputs?

	AUS	AUT	ARM	BLZ	CAN	CHE	EAC	ESP	ETH	FRA	GBR	GEO	IDN	ITA	JPN	LUX	MEX	NLD	NOR	NZL	TJK	USA	ZAF
Central Bank		✓	✓				✓		✓			✓	✓		✓		✓	✓	✓	✓		✓	
Treasury or Finance													✓						✓				
Academics									✓				✓										
Economists			✓						✓				✓						✓		✓		
Other													✓					✓				✓	
None	✓			✓	✓	✓		✓		✓	✓			✓		✓							✓