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Core inflation over the COVID-19 pandemic

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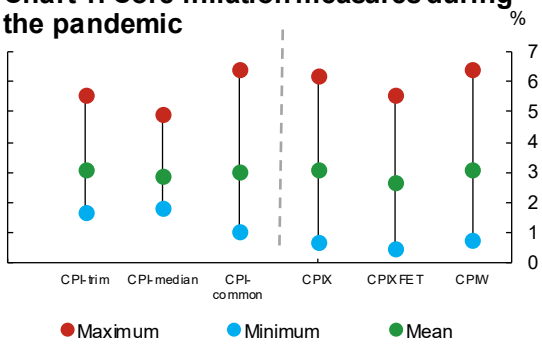
Summary

Since 2015, the Bank of Canada has used a set of three measures of core inflation to inform its assessment of underlying inflation. This approach to both measuring and using core inflation is based on the fact that:

- no single measure of core inflation provides the appropriate signal for monetary policy in every situation
- core inflation is just one input into a broad assessment of inflationary pressures

The three preferred measures of core inflation—CPI-trim, CPI-median and CPI-common—were initially chosen mainly because of their empirical properties (**Chart 1**). Between 1992 and 2014, these measures were found to best capture the persistent component of inflation and consequently move with macroeconomic drivers. The most recent thorough review of core inflation measures was undertaken in 2019. This assessment supported the use of these three preferred measures. The ranking of measures based on statistical criteria used in past assesments is much the same if updated with data up to September 2022.

Chart 1: Core inflation measures during the pandemic



Source: Statistics Canada and Bank of Canada calculations

In this note, we take a different approach to past assessments of core inflation, treating the COVID-19 pandemic as a case study. COVID-19 was an unprecedented and complex shock, challenging the conventional use and interpretation of various economic models and indicators. We ask which measures of core inflation provided the best signal of underlying inflationary pressures in this environment.

Key messages

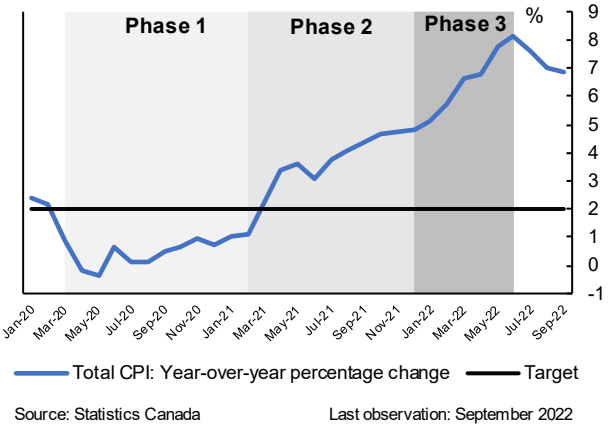
- CPI-trim and CPI-median provided a reliable gauge of underlying inflation throughout the pandemic. These measures eased as the economy weakened in early 2020 but signalled that COVID-19 was not a broadly disinflationary shock. They subsequently provided an early warning that underlying inflation was becoming uncomfortably high. The favourable performance of these measures is largely because they do not rely on the historical behaviour of prices—an especially valuable feature in unprecedented times.
- CPI-common and alternative measures of core inflation all rely on historical experience in different ways. This reliance on historical experience proved misleading for assessing inflationary pressures over much of the pandemic.
- Although recent revisions have brought the path of CPI-common during the pandemic largely in line with those of CPI-trim and CPI-median, it may be necessary to refine the methodology to improve CPI-common's reliability in real time.
- These results suggest placing greater emphasis on CPI-trim and CPI-median when assessing underlying inflation.

Phases of inflation over the pandemic

We discuss three distinct phases of inflation dynamics during the pandemic (**Chart 2**):

- Phase 1, from March 2020 to February 2021—a period of below-target inflation
- Phase 2, from March to December 2021—a period in which inflation rose outside of the control range, hovering around 5% as price increases moderated toward the end of the year
- Phase 3, from January to June 2022—a period of inflation accelerating rapidly and broadening, gaining 3 percentage points in 6 months to arrive at a peak of 8.1%

Chart 2: Phases of CPI inflation



Source: Statistics Canada Last observation: September 2022

In addition to the Bank's set of preferred core inflation measures, we assess three common alternative measures (**Table 1**). These measures either exclude or give less importance to traditionally volatile components of the consumer price index (CPI) and featured more prominently in Bank analyses before 2015. We use real-time readings of CPI-common in our assessment. This is important because CPI-common has recently undergone sizable revisions, making the latest estimates significantly different from those available to the Bank in real time.

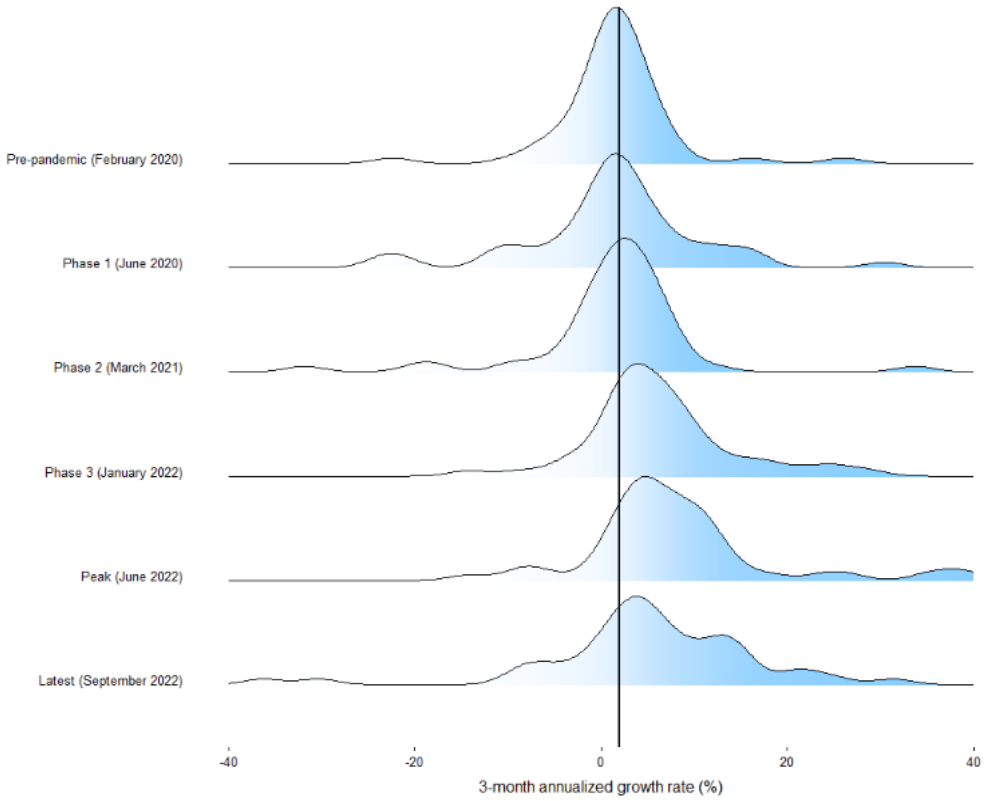
We guide our assessment of core inflation using careful analysis of the distribution of price changes across the CPI basket at the start of each phase of the pandemic. We will therefore refer to **Chart 3** often because it shows how this distribution changed throughout the pandemic. We focus on the distribution of 3-month inflation rates because they:

- are less backward-looking than annual rates
- avoid overlapping periods of the price distributions when referring to different phases of the pandemic

Table 1: Core inflation measures

Measure	Description
CPI-common	Tracks common price changes across categories in the CPI basket
CPI-median	Corresponds to the price change located at the 50th percentile (in terms of CPI basket weights) of the distribution of price changes each month
CPI-trim	Excludes CPI components whose rates of change in a given month are in the tails of the distribution of price changes
CPIX	Excludes eight of the most volatile components of the CPI and the effect of indirect tax changes on the remaining components
CPIXFET	Excludes food, energy and the effect of changes in indirect taxes
CPIW	Weighs each CPI component inversely proportional to its historical volatility

Chart 3: Distribution of 3-month price changes across the CPI basket[1]



Note: For visual purposes, some outliers have been excluded from the tail ends of the distributions.

Phase 1: CPI inflation plummets amid an uneven shock

Phase 1 represents the initial months of the COVID-19 pandemic. Although total CPI inflation fell sharply, both high and low inflation became more widespread across the CPI basket. This was consistent with the shock being highly uneven across sectors of the economy and is represented graphically by both tails of the inflation distribution becoming wider (**Chart 3**). Extreme observations were somewhat more prevalent in the left tail of the distribution, partly reflecting one-off price declines for services affected by COVID-19 lockdowns and outsized declines in energy prices.

Phase 1 did not appear to be characterized by widespread disinflation, although some measures of core inflation fell sharply. Declines were most apparent outside the Bank's preferred measures, with alternative measures of core inflation falling toward the lower end of the Bank's inflation-control range (**Table 2**). This apparent inconsistency is mainly because the alternative measures of core inflation are based on historical volatilities of CPI components. Therefore, those measures tend to be useful only when the past acts as a reasonable guide to the future. But COVID-19 was an unprecedented shock, with large temporary price movements in CPI components that had historically not been very volatile.

[1] Although Phase 1 begins in March 2020, we plot June 2020 because it is the first month in which the 3-month annualized inflation rate does not contain pre-pandemic price changes.

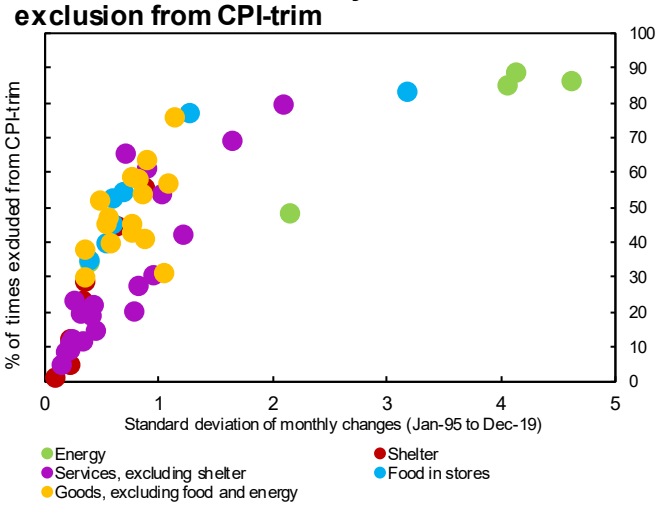
Table 2: Snapshot of preferred and alternative measures of core inflation in June 2020

	CPI-common	CPI-median	CPI-trim	CPIX	CPIXFET	CPIW
Year-over-year percentage change (%)	1.5	1.9	1.8	1.1	1.0	1.2
3-month annualized rate (%)	1.1	1.4	1.2	0.6	0.0	-0.5

CPI-common eased significantly in Phase 1 as well. This measure is also constructed based on historical experience but in a different way than the alternative measures of core inflation are. CPI-common weights CPI components based on the degree of their historical common price movements. In the past, goods prices tended not to move much with the rest of the components in the CPI basket, meaning CPI-common entered the pandemic attaching much more importance to services prices. As a result, it was not particularly well-suited to assessing underlying inflation during an uneven shock.

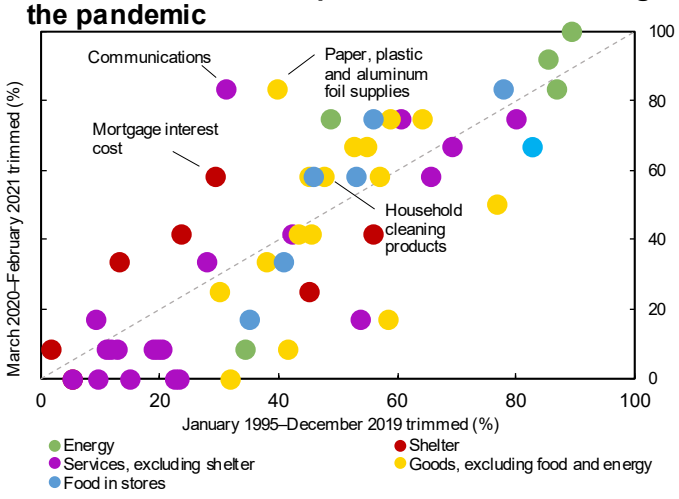
In contrast, CPI-trim and CPI-median eased modestly in Phase 1 to just below 2%. These measures are not determined by historical relationships. Instead, they are constructed using the distribution of price changes at each point in time. This flexibility—especially valuable at the onset of the pandemic—explains why CPI-trim and CPI-median performed favourably in the Bank's previous empirical analyses of core inflation. As **Chart 4** shows, inflation outliers are often observed outside of traditionally volatile categories such as food and energy. Moreover, early in the pandemic, some CPI categories were outliers much more often than they had been in the past (**Chart 5**).

Chart 4: Historical volatility vs incidence of exclusion from CPI-trim



Sources: Statistics Canada and Bank of Canada calculations

Chart 5: Trimmed components before and during the pandemic

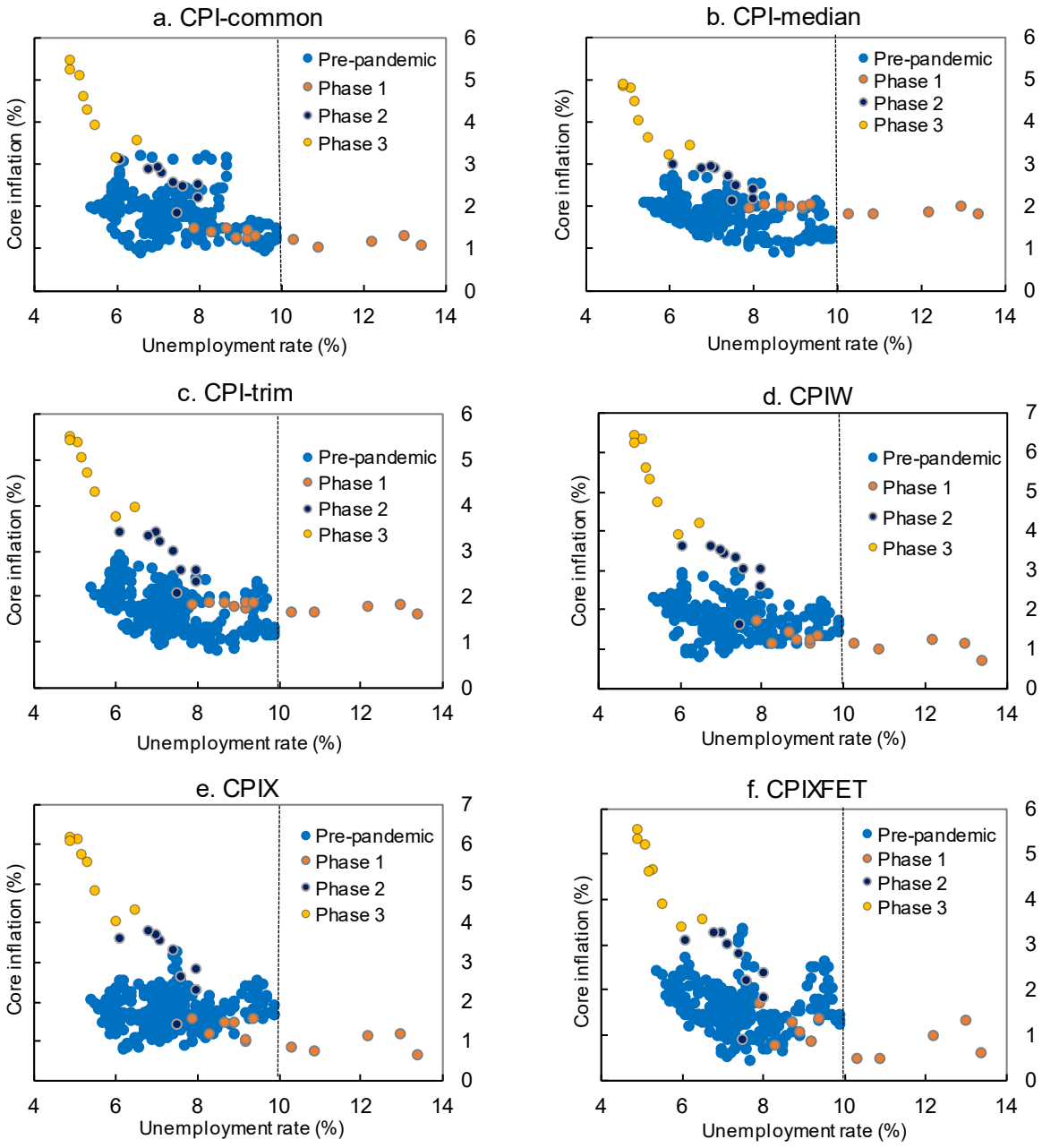


Sources: Statistics Canada and Bank of Canada calculations

Overall, some easing in core inflation was to be expected in Phase 1 given the rapidly deteriorating economic conditions. That said, **Chart 6** shows that none of the measures aligned well with economic slack during Phase 1. This may reflect the unique nature of the COVID-19 shock, with an exceptionally large but short-lived increase in unemployment. Moreover, this increase occurred against the backdrop of COVID-19 lockdowns and signficant fiscal income support, which likely offset the typical disinflationary impact of high unemployment. Thus, the Phillips curve was not informative for choosing between competing measures of core inflation in Phase 1. Instead, the distribution of prices changes during Phase 1 proved to be highly informative, depicting the uneveness of the COVID-19 shock and

suggesting only modest disinflationary pressure on net. Ultimately the evolution of CPI-trim and CPI-median best reflected this.

Chart 6: Phillips curves for core inflation measures



Source: Statistics Canada

Phase 2: CPI inflation surpasses the inflation target

The second phase begins in early 2021, when year-over-year total CPI inflation reached the 2% target for the first time since the start of the pandemic. This marked a pivotal moment for inflation. Had inflation simply returned to normal after a period of weakness, or were broader inflationary pressures building? **Chart 3** shows that the wider left tail of the inflation distribution observed during Phase 1 had largely returned to normal by Phase 2. At the same time, the wider right tail had widened further. In other words, the unevenness of Phase 1 was becoming increasingly one-sided, with high inflation more prominent across the CPI basket.

Measures of core inflation, however, continued to provide mixed signals. CPI-trim and CPI-median both slightly exceeded 2% on a year-over-year basis at the start of Phase 2. More importantly, their 3-month annualized inflation rates were around 3% (**Table 3**). This suggested that annual rates were likely to rise further, with a significant risk of exceeding the upper bound of the inflation-control range. Thus, CPI-trim and CPI-median were warning that underlying inflation was high and rising. As **Chart 6** shows, these dynamics were taking hold at the same time as the unemployment rate was rapidly falling. This is consistent with the historically tight correlation between measures of economic slack and CPI-trim and CPI-median.

Table 3: Snapshot of preferred and alternative measures of core inflation in March 2021

	CPI-common	CPI-median	CPI-trim	CPIX	CPIXFET	CPIW
Year-over year percentage change (%)	1.5	2.1	2.1	1.4	0.9	1.6
3-month annualized rate (%)	1.4	2.6	3.0	1.5	1.5	2.4

Alternative measures of core inflation, however, remained relatively subdued. Although they had risen significantly from their lows in Phase 1, they remained below 2% on both a year-over-year and a 3-month annualized basis. They were also historically low given the prevailing level of the unemployment rate (**Chart 6**). However, these measures rose sharply starting in April 2021. By May, they had caught up with CPI-median and CPI-trim. Beginning in May, most measures of core inflation moved largely in sync.

The one exception was CPI-common, which rose to 1.8% in April 2021 but then remained relatively flat for the rest of the year. Although inflation was broadening across a range of goods and services, the initial rise in inflation was driven by goods inflation, which CPI-common was giving less importance to. At the time, goods inflation was being driven by global factors (such as commodity prices and supply chain disruptions), making CPI-common a convenient gauge of more domestically generated pressures. But high goods inflation proved to be widespread and persistent, spilling over across CPI categories.

Phase 3: High inflation becomes pervasive

By the third phase in early 2022, the mixed signals of Phase 2 had given way to unambigously pervasive inflationary pressures. The distribution of price changes, which had shifted notably to the right (**Chart 3**), clearly shows this. Momentum had continued to build across measures of core inflation, with almost all

3-month annualized rates well above 3% at the beginning of Phase 3 (**Table 4**). CPI-common continued to lag behind other measures of core inflation but was above 2% for the first time during the pandemic. CPI-common kept rising significantly throughout Phase 3, eventually catching up with the other measures by June. This strengthening of core inflation coincided with further improvements in economic conditions, as the unemployment rate headed toward an all-time low (**Chart 6**).

Table 4: Snapshot of preferred and alternative measures of core inflation in January 2022

	CPI-common	CPI-median	CPI-trim	CPIX	CPIXFET	CPIW
Year-over-year percentage change (%)	2.3	3.4	4.0	4.3	3.5	4.2
3-month annualized rate (%)	2.9	4.3	4.7	4.9	3.6	4.9

In Phase 3, the particular choice of core inflation measure was not especially important—they all provided largely the same message. Indeed, with elevated inflation highly synchronized across the CPI basket, it is not surprising that different combinations of CPI components yielded similar results.

The current situation

CPI inflation has declined in recent months, but most of that decline reflects a drop in gasoline prices. Inflation remains widespread (**Chart 3**), and core inflation is becoming increasingly important in detecting a more fundamental turning point.

Based on our findings, we believe that CPI-trim and CPI-median should be relied on more to assess underlying inflation. Not only have CPI-trim and CPI-median performed well historically, but they also met the unprecedented challenge of assessing underlying inflation during a pandemic. The favourable performance of these measures largely stems from their lack of reliance on historical relationships, making them more robust to changes in the behaviour of prices. In September 2022, the 3-month rates of inflation for CPI-trim and CPI-median were around 4% (**Table 5**)—an early and encouraging sign that price pressures are easing. However, further sustained declines are needed for meaningful progress to be made toward the inflation target.

Table 5: Snapshot of preferred and alternative measures of core inflation in September 2022

	CPI-common	CPI-median	CPI-trim	CPIX	CPIXFET	CPIW
Year-over-year percentage change (%)	6.0	4.7	5.2	6.0	5.4	6.0
3-month annualized rate (%)	4.0	3.5	3.7	4.4	4.9	2.6

As for CPI-common, simulations suggest more upward revisions are possible in the coming months. But beyond the near term, revisions are likely to become less prominent, restoring the real-time reliability of this measure. In future work, Bank staff will explore potential changes to the methodology used to construct CPI-common to make it less prone to revisions when faced with large shocks.

While we focus on core inflation in this note, we stress that core inflation is only one input into a broad assessment of inflationary pressures. This assessment includes tracking input costs, demand and supply imbalances, and measures of inflation expectations.