

# Has the Inflation Process Changed? Selective Review of Recent Research on Inflation Dynamics

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## Abstract

For most of 2011–19, inflation in Canada and advanced economies registered below inflation targets. This has spurred a debate on whether “lowflation” is a temporary phenomenon or rather a sign of a fundamental change in inflation behaviour—in Canada and globally. So far, we know little. Global factors—changes in the price of oil and shifts in trade due to globalization—can only explain a portion of the fluctuations in domestic inflation. Emerging survey data are showing that inflation expectations of managers and households behave very differently from model expectations based on full information and rational behaviour. Recent surveys using randomized control trials reveal that changes in monetary or fiscal policies may lead to unexpected responses of inflation expectations and firm behaviour. Changes in the markets for consumer goods raise the need for us to rethink the methods for measuring inflation. We discuss the questions that these observations bring up for central bankers.

*Bank topics: Central bank research; Inflation and prices; Monetary policy*

*JEL codes: E31, E52*

## Résumé

Pendant la plus grande partie des années 2011 à 2019, l’inflation au Canada et dans les économies avancées a été inférieure aux cibles d’inflation. Cette situation a relancé le débat sur la question de savoir si l’inflation faible au regard des objectifs de la politique monétaire est un phénomène temporaire ou plutôt le signe d’une transformation fondamentale du comportement de l’inflation, au Canada et ailleurs. On en sait encore peu sur cette question. Les facteurs extérieurs – variations du prix du pétrole et évolutions des échanges commerciaux provoquées par la mondialisation – ne peuvent expliquer qu’une partie des fluctuations de l’inflation intérieure. Selon de nouvelles données d’enquête, les attentes d’inflation des dirigeants d’entreprise et des consommateurs se comportent très différemment des attentes rationnelles en situation d’information parfaite prises en compte dans les modèles. Les résultats d’enquêtes récentes reposant sur les techniques d’expérimentation aléatoires révèlent que des changements d’orientation des politiques monétaires ou budgétaires peuvent donner lieu à des réactions inattendues des attentes d’inflation et des comportements des entreprises. La transformation des marchés des biens de consommation souligne la nécessité de repenser les façons de mesurer l’inflation. Nous analysons les enjeux pour les banquiers centraux que ces observations mettent en évidence.

*Sujets : Recherches menées par les banques centrales; Inflation et prix; Politique monétaire*

*Codes JEL : E31, E5*

# 1. Recent inflation in Canada and advanced economies

In Canada, by the end of 2019 measures of both headline and core inflation were at target, consistent with an economy operating near capacity. However, for most of 2011–19, inflation was below the 2 percent target. As shown in **Chart 1**, inflation over this period has been below target in many other advanced economies as well. Indeed, in some cases, it has dropped to near-zero or even negative rates, particularly in the case of headline inflation.

However, the duration and severity of low inflation episodes have varied across economies. Inflation in Canada, the United States, the United Kingdom, Sweden and New Zealand returned closer to their 2 percent targets by the end of 2019. In Australia, inflation has been near the bottom of or below the Reserve Bank of Australia’s 2 to 3 percent inflation target range for several years. Similarly, inflation in the euro area and Japan has remained weak. This lack of inflationary pressure may seem particularly surprising given the continuing expansion of monetary and fiscal policy programs since 2008 in many of these economies.

Such evidence has spurred a debate on whether “lowflation” is a temporary phenomenon or rather a sign of a fundamental change in inflation behaviour, in Canada and globally.<sup>1</sup>

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<sup>1</sup> Recent literature reviews on low inflation are provided, for example, in Bhatnagar et al. (2017); Ciccarelli and Osbat (2017); Ha, Kose and Ohnsorge (2019); and Ehrmann et al. (2020).

**Chart 1: Consumer price index inflation in Canada and advanced economies, 2011–19**  
Year-over-year percentage changes



Note: The inflation targets in these charts reflect explicit targets announced by central banks that have an asymmetric target or target band. They report the upper bound or midpoint when specified by central banks that have an asymmetric target or target band. Otherwise, when a midpoint is not specified, the bounds of the range are reported. The reported measures of core inflation correspond to the preferred measures of central banks when specified and to broadly comparable exclusion measures otherwise. In the case of Sweden, which in 2017 changed its inflation target to the consumer price index with fixed interest rates (CPIF) rather than consumer price index (CPI) inflation, the CPIF measures are reported over the whole period included in the charts. In the case of Japan, the inflation data reported here exclude the impact of changes to the consumption tax, and the dashed line indicates the Bank of Japan's inflation goal that preceded its inflation target. Detailed country-specific notes are provided in the Appendix.

## 2. Traditional approach: the Phillips curve and global factors

A widely used Phillips curve equation associates inflation fluctuations with measures of economic slack in the economy, inflation expectations and other relevant variables, such as the exchange rate pass-through and commodity prices.<sup>2</sup>

According to Bank of Canada analyses, the Phillips curve accounts for roughly 70 percent of the consumer price index (CPI) deviations in Canada and advanced economies, and it can point to possible sources of those deviations. For example, in Canada, weaker inflation in 2014–15 was mostly attributed to low oil prices, and over 2016–17, to heightened competition among Canadian food retailers.

Not surprisingly, high co-movement of country-specific inflation rates suggests an important role of global factors (Cicarelli and Mojon 2010). Indeed, augmenting the Phillips curve estimation with global variables—foreign output gap, commodity prices, real exchange rates, global price dispersion—can improve domestic inflation forecasts for at least half of the countries in the Organisation for Economic Co-operation and Development (Medel, Pedersen and Pincheira 2016). Moreover, the importance of the global component of domestic CPI inflation has more than doubled since the 1990s (Forbes 2019). Auer, Borio and Filardo (2017) argue that globalization has made domestic inflation more sensitive to global factors.

This approach, however, has at least two limitations:

First, the global component of CPI inflation is driven by food and commodity prices, and therefore it is less useful for explaining fluctuations in core inflation. Furthermore, the factors affecting the relative importance of the “global inflation” component are not entirely clear. Estimates of global inflation tend to be sensitive to country sets, time period, regressors and measures of slack. For example, Bobeica and Jarociński (2019) estimate that domestic factors were more important than global factors for euro area headline inflation in 2012–14.

Second, an increased role of global factors is often linked to *higher* inflation volatility. Poloz (2016) surveys evidence that suggests increased trade openness raises the volatility of the domestic output gap. This is due to the spread of international input-output linkages, increased synchronization of business cycles or heightened specialization of trade industries. Recent literature on the price of oil—another key global variable—has pointed out its increased sensitivity to macroeconomic news.

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<sup>2</sup> For example, to estimate Phillips curve equations for Canada and advanced economies, the Bank of Canada uses the output gap as a measure of slack; long-term expectations or a constant as proxies for inflation expectations; and lag inflation, lag of relative import price, and nominal oil price as additional variables. Schembri (2019) points out that for Canada, core inflation measures strongly correlate with output gap measures, supporting the relevance of the Phillips curve relationship for core inflation in Canada.

This can be caused by monetary policies constrained by the zero lower bound; higher uncertainty; increased financialization of commodities; and decreased share of US oil imports. Killian (2009) shows that fluctuations in the real price of oil may have very different dynamic effects on inflation (and macro variables) depending on their underlying sources. Charnavoki and Dolado (2014) break down these sources for Canada.

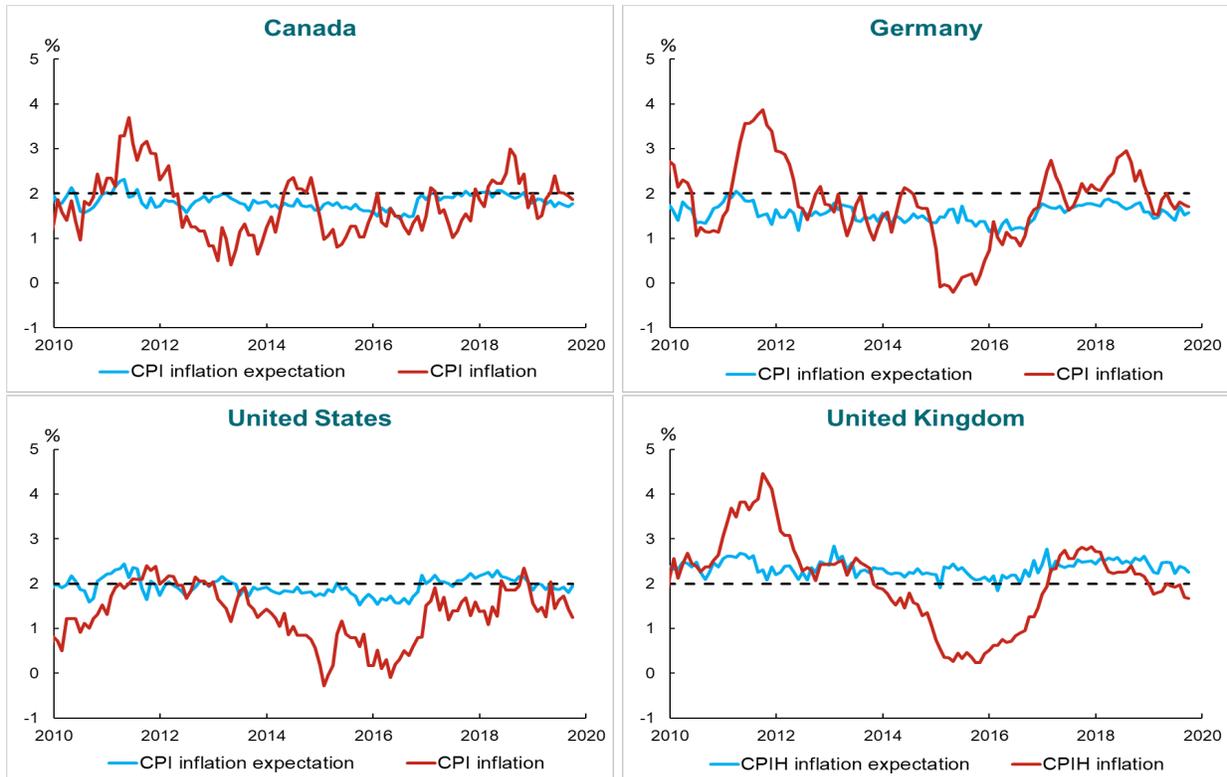
### 3. Recent dynamics of inflation expectations

Factors that contribute to economic slack are obvious candidates for explaining low inflation. However, a rapidly expanding literature argues that the primary driver of inflation since the Great Recession has been public expectations of future inflation rather than economic slack (Jordà et al. 2019). When firms update prices for their goods or services, they need to understand the current economic conditions and, importantly, how these conditions are likely to evolve in the future. That is why firms' expectations—and inflation expectations in particular—have direct influence on inflation, as captured in the Phillips curve equation. Traditionally, macroeconomic models have relied on full-information rational expectations with an ad hoc backward-looking component (Clarida, Gali and Gertler 1999; Woodford 2003). This approach to expectations has come under scrutiny with the emergence of direct evidence on how firms, households and professionals form their forecasts.

To shed light on inflation puzzles, the evolving literature has examined alternative models of expectations. One idea is that successful inflation targeting made inflation expectations less sensitive to disturbances, thus making it more difficult for the central bank to steer inflation back to target (Eusepi et al. 2019; Jorgensen and Lansing 2019; Jain 2019). A second direction is to relax “model consistency” of expectations in favour of matching the behaviour of expectations in the survey data. Coibion, Gorodnichenko and Kamdar (2018) show that this approach can address the shortcomings of traditional modelling of expectations. Friedrich (2016) argues that inclusion of household inflation expectations in the Phillips curve can account for both higher-than-expected inflation across advanced economies from 2009 to 2012 and weakening inflation since 2012.

An alternative to modelling expectations is to use more direct measures, derived from either prices of financial instruments or forecasts of economic and financial professionals, households or firms.

**Chart 2: Market-based inflation expectations**



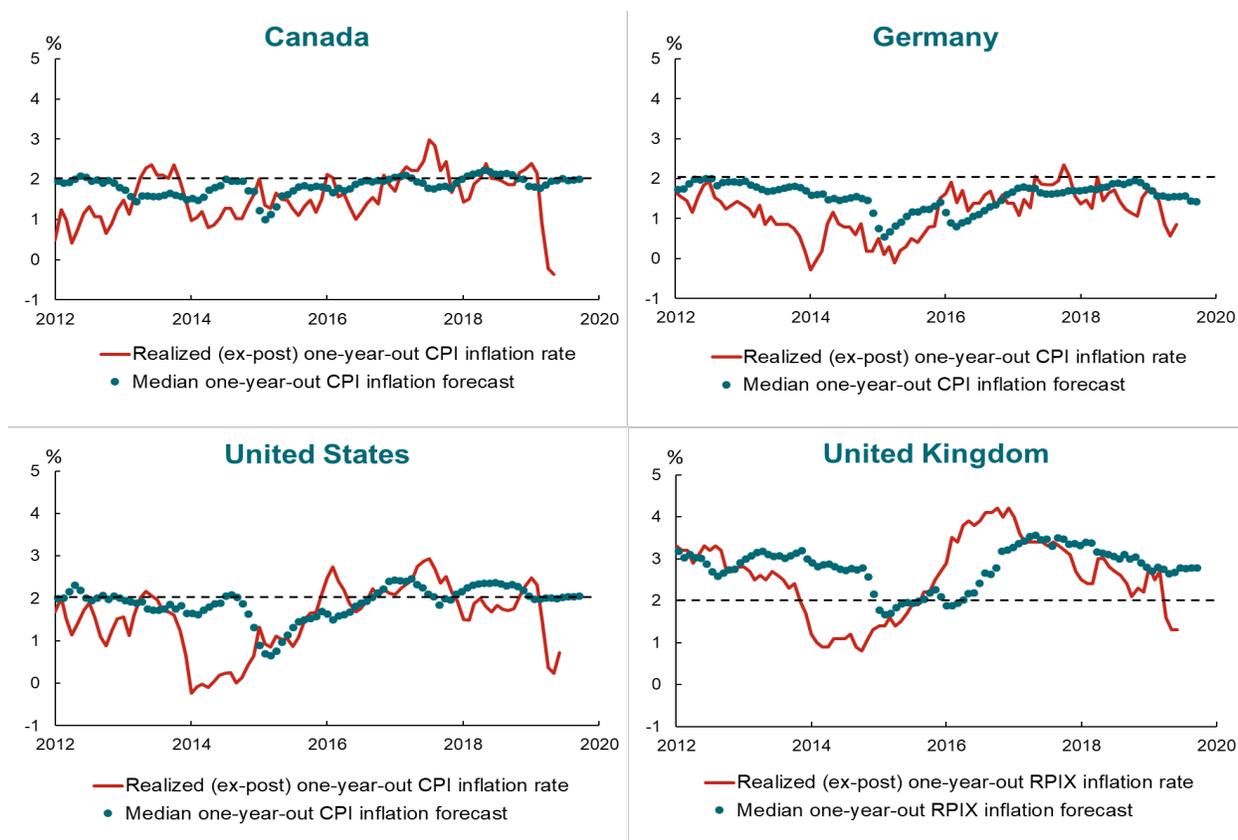
Notes: Long-term inflation expectations are estimated from 10-year break-even inflation rates net of inflation risk premium. Break-even inflation rates are the yield spreads between 10-year nominal bonds and 10-year inflation-indexed bonds from respective countries. Inflation for consumer price index (CPI) and consumer price inflation including owner occupiers' housing costs (CPIH) are provided as year-over-year percentage changes.

Sources: Datastream, Bank of Canada calculations

Market-based expectations of long-run inflation can be constructed by comparing the returns on nominal and real bonds. **Chart 2** shows that in Canada, the United States, Germany and the United Kingdom, the selected market-based inflation expectations have been well anchored around 2 percent targets. This was the case even as inflation itself deviated from the target for long stretches of time.

These measures of market-based expectation offer two main advantages. First, they provide almost immediate information about the response of expectations to macroeconomic developments and policy announcements (Nakamura and Steinsson 2018). Second, they can also be compared with other drivers of bond yields—the natural rate of interest, the term premium, inflation risk premium, and the global and domestic factors—which makes them very useful for policy analysis.

**Chart 3: Inflation expectations of professional forecasters**



Notes: The green dots represent a weighted average of weighted median current-year and weighted median one-year-out consumer price index (CPI) inflation forecasts from professional forecasters. Red lines are one-year-out inflation rates for CPI and all items retail price index excluding mortgage interest payments (RPIX), provided as year-over-year percentage changes. Source: Consensus Economics

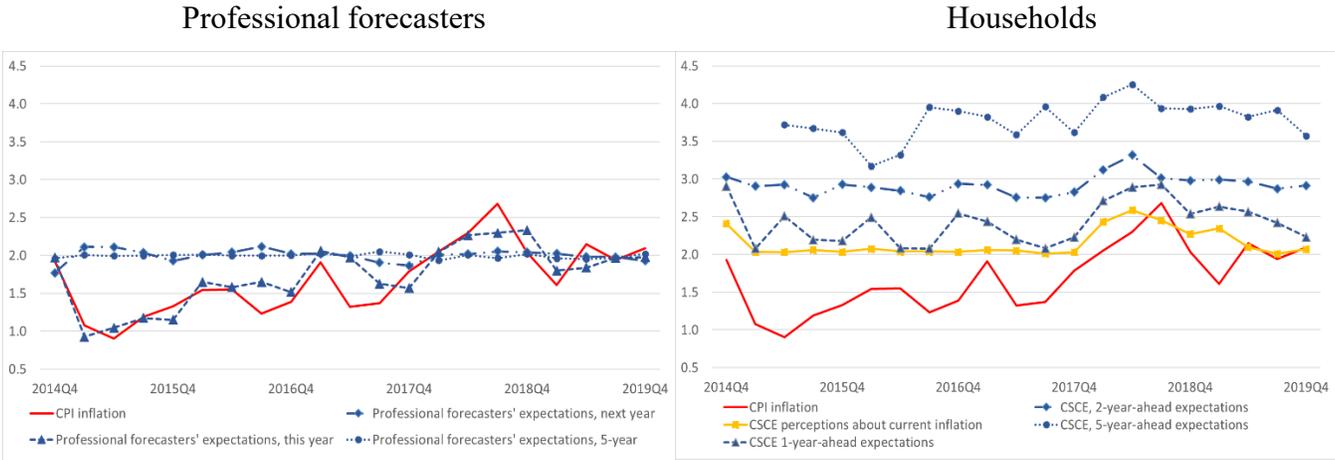
Professionals who understand and follow financial markets exhibit inflation expectations that are largely in line with expectations derived from financial instruments. **Chart 3** shows that the median one-year-out inflation forecast in surveys of professional forecasters is fairly accurate, especially in Canada. Still open is the question of whether expectations of professional forecasters provide a more accurate measure of inflation expectations than market-based measures that assign high weight to past inflation and depend on inflation risk premiums (Bauer and McCarthy 2015).

An important limitation of using market-based or professional inflation expectations is that they do not represent the inflation expectations of firm managers, who may be less informed about financial markets or policy changes. Because prices are set by non-financial firms, the expectations of non-financial firms—or rather, their managers—are most relevant to inflation dynamics. Therefore, surveys of firm managers may provide a more accurate view of the behaviour of inflation expectations that most directly impact actual inflation. Coibion and Gorodnichenko (2015) have shown that the forecasts of firm managers are very similar to those of households. Therefore, households' forecasts can be used when data on firms' forecasts are not available.

Surveys of firms or households may yield very different results than surveys of financial market participants or professional forecasters. For example, during the early 2010s, when headline inflation was low in most advanced economies, professional and market-based inflation forecasts improved but expectations of households declined (Coibion and Gorodnichenko 2015).

For Canada, these differences are highlighted in the Bank’s Canadian Survey of Consumer Expectations (CSCE) (Gosselin and Khan 2015; Schembri 2020). **Chart 4** shows that while inflation expected by professional forecasters was aligned with CPI inflation between 2014 and 2019, households tended to expect inflation to be above both the actual inflation and the 2 percent inflation target. Unlike the inflation expectations of professional forecasters, for whom long-term forecasts were anchored around the 2 percent target, consumers’ expectations moved farther above the target as the horizon increased. When actual inflation was persistently below the target, consumers perceived it to be close to the target (Kostyshyna and Kpekou Tossou 2019). And if consumers perceive inflation to be higher in the past, they are more likely to expect it to stay high in the future (Schembri 2020).

**Chart 4: Average inflation expectations**

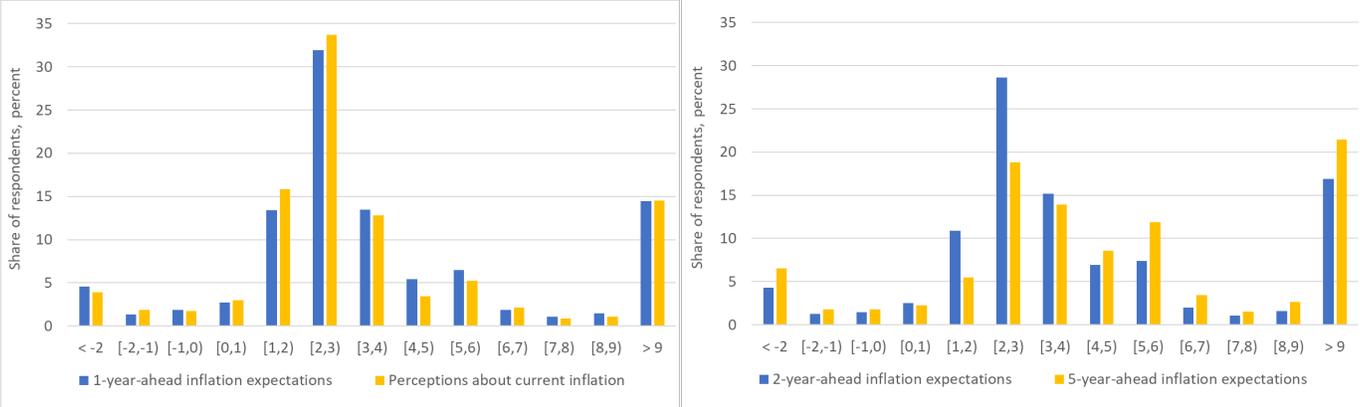


Note: Mean values across professional forecasters, median values across households.  
 Sources: Statistics Canada, Consensus Economics, Bank of Canada calculation based on Canadian Survey of Consumer Expectations

Households’ expectations disagree not only with actual inflation but also with each other. According to the CSCE (Bank of Canada 2019), most households had inflation expectations within or close to the 1 to 3 percent inflation-control range, although a large fraction reported expected or perceived inflation outside the band (**Chart 5**). Around 15 percent of respondents believed that inflation would be or had been above 9 percent, which is striking given that inflation has averaged 2 percent per year for almost three decades. Even in surveys of professional forecasters, the stability of median inflation expectations often masks significant dispersion and volatility of individual expectations (Binder, Janson and Verbrugge 2019). This evidence suggests the behaviour of average household expectations should not be generalized to all households, as assumed in mainstream policy models.

Surveys of expectations of managers reveal similar results. For example, evidence from the Business Outlook Survey shows that, like households, at least one-third of firms in Canada perceive inflation to be outside the 1 to 3 percent target range, typically above it (**Chart 6**) (Richards and Verstraete 2016; D’Souza et al. 2020). Coibion, Gorodnichenko and Kumar (2018) document similar evidence for New Zealand, where the mean forecast of inflation among firms was 5.3 percent, with a cross-sectional standard deviation of 3.1 percent.

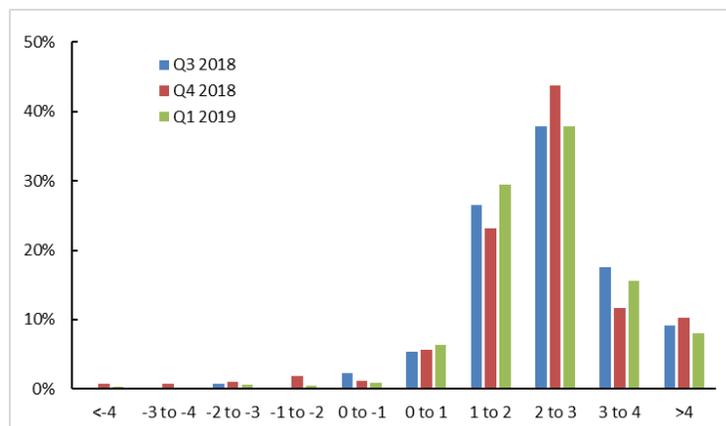
**Chart 5: Inflation expectations of households in Canada**



Notes: Canadian Survey of Consumer Expectations questions are as follows. Inflation expectations for each horizon: “What do you expect the rate of inflation (deflation) to be?” Perceptions about current inflation: “What do you think the rate of inflation (deflation) was over the last 12 months?”

Source: *Canadian Survey of Consumer Expectations—Fourth Quarter of 2019* (Bank of Canada 2019)

**Chart 6: Inflation expectations of firms in Canada**



Notes: Share of firms' responses to the question: "Over the next 2 years, what is your expectation for the annual rate of inflation (deflation), based on the Canadian Consumer Price Index?"

Source: D'Souza et al. (2020).

In sum, firms and households seem "unaware of even dramatic monetary policy announcements, and more generally display almost no knowledge of what central banks do" (Coibion, Gorodnichenko and Weber 2019, 1). The disconnect between inflation expectations and actual inflation suggests that the influence of monetary policy on inflation through interest rates and management of expectations may be weaker than previously thought. Thus, the current practice of central banks' targeting their communication to sophisticated financial market participants and professional forecasters may limit the impact of monetary policy on the decisions of households and firms—and ultimately the overall economy.

## 4. Understanding the links between expectations and behaviour

One explanation for the behaviour of firm and household inflation expectations is information problems. Unlike professional forecasters, households or firm managers often lack information about and understanding of economic developments and policy changes. For these agents, the value of such information is too low or the cost of accessing or processing it is too high, so they choose to be less informed. Furthermore, households and managers may differ vastly in their ability to stay informed.

When information is not readily available, individuals naturally rely on their personal experiences as consumers to form inflation expectations (Bruine de Bruin, van der Klaauw and Topa 2011). D'Acunto et al. (2019) provide evidence that the frequency and size of price changes consumers face in their daily lives while grocery shopping have an impact on their inflation expectations. Coibion and Gorodnichenko (2015) show that consumers perceive gasoline prices as salient indicators of inflation. They argue that rising oil prices in the 2000s raised households' inflation expectations and kept inflation from falling in the aftermath of the Great Recession. The

subsequent fall in oil prices in 2014 may have brought inflation expectations down, along with inflation. Note that because food and gasoline prices are often excluded from core measures of inflation, designing measures of inflation expectations from such core inflation measures may lead to erroneous conclusions. The Bank's current preferred measures of core inflation—CPI-trim, CPI-median and CPI-common—do not explicitly exclude gasoline and food prices and are statistically better behaved than alternative core measures (Lao and Stein 2019).

An alternative explanation for the upward bias of inflation expectations, proposed by Afrouzi and Veldkamp (2019), is that individuals are uncertain about expected inflation but correctly believe it to be positively skewed, and as a result they assign a greater weight to higher inflation outcomes. Both dispersion and positive skewness of individual expectations are borne out in survey data, including for Canada (Bank of Canada 2019).

Remarkably, even when inflation information is readily available, individuals often assign significant value to less accurate sources of information. When survey respondents are asked about the inflation rate and are informed about the most recent inflation rate or the central bank's inflation target, they still try to recall prices they have seen during their own shopping (Bruine de Bruin, van der Klaauw and Topa 2011; Coibion, Gorodnichenko and Kumar 2018).

In advanced economies, the lack of attention to inflation may be explained by a long history of low and stable inflation rates and reliable statistics. Cavallo, Cruces and Perez-Truglia (2017) document that when individuals are told official inflation statistics, those individuals who reside in low-inflation countries assigned three times lower weight to the prices they personally observed than individuals in high-inflation countries.

Inflation experiences differ among individuals, which may explain the wide dispersion in survey expectations. Johannsen (2014) finds that low-income households experience more dispersion in changes of their cost of living and display more heterogeneity in their inflation forecasts. Bellemare, Kpekou and Moran (2019) use evidence from the CSCE and find that female consumers, young consumers and consumers with lower income or low education tend to report higher inflation expectations. These findings are largely consistent with survey evidence for the United States (Bruine de Bruin et al. 2010; Madeira and Zafar 2015). One noteworthy exception pointed out by Bellemare, Kpekou and Moran (2019) is that Canadian households' expectations are less dispersed and more clustered around the 2 percent target than US households. This suggests that a longer history of inflation targeting in Canada played a role in anchoring households' expectations.

What do inflation expectations mean for household and firm decisions? In standard models, a strong forward-looking component of expectations implies that changes in expectations exert an immediate effect on economic behaviour (Dräger and Nghiem forthcoming). For example, raising inflation expectations should lead to lower perceived real interest rates, thereby stimulating economic activity. However, testing the causal links between expectations and decisions is challenging because expectations themselves depend on past economic outcomes.

Recent work using surveys of forecasters adopted randomized control trials to generate exogenous variation in expectations. In these studies, a randomly chosen subgroup of participants is treated

with information that influences their inflation beliefs—for example, the official inflation rate. The experimenter can then derive the effect of expectations on actions by comparing the responses of treated and untreated subgroups.

Several lessons emerge from this literature:

First, the effects can be large, although they are short-lived. For example, Coibion, Gorodnichenko and Weber (2019) find that communicating simple inflation information—such as the recent inflation rate, the Federal Reserve’s inflation target or the Federal Open Market Committee inflation forecast—can reduce average inflation expectations by 1.0 to 1.2 percentage points. This is much larger than the effect of conventional monetary policy or forward guidance.

Second, how information is communicated matters. Simple statistics about inflation have a significant effect on inflation expectations. Randomized information treatments applied to firms show that firms respond strongly to (1) information about recent inflation or the inflation target (Coibion, Gorodnichenko and Kumar 2018) and (2) their beliefs about other firms’ expectations (Coibion et al. 2018). Bholat et al. (2019) and Kryvtsov and Petersen (2020) show that when information is more relatable to individuals’ experiences, it more effectively influences their expectations. Such findings suggest that for a central bank’s communication to have an impact, it would have to be tailored to narrower population subgroups and would have to persist over time.

Third, the effects of information on inflation expectations and behaviour are complex. For example, when treated firms in Coibion, Gorodnichenko and Kumar’s (2018) New Zealand survey upwardly revised their expectations, they report higher employment and investment, which is consistent with predictions of standard macroeconomic models. These results are reversed for Italy, where, in response to a similar information treatment, firms report a *decrease* in sales, employment and investment over the next year (Coibion, Gorodnichenko and Ropele 2019). The interpretation is that Italian firms that realize higher inflation expectations become pessimistic about the economic outlook and their ability to get credit. Another finding at odds with predictions of standard models is provided in Coibion et al. (2019), who show that when Dutch households raise their inflation expectations, their spending on durables falls.

How households interpret information may be more complex than previously thought. The absence of a discretionary increase in households’ spending following an increase in their inflation expectations could account for the small effects of policies based on the expectations channel, such as forward guidance. The takeaway is that communication of policies aimed to move inflation expectations may lead to unexpected and detrimental outcomes to the economy, and, therefore, it should be studied further.

## 5. Trends and measurement

Structural changes in the market for consumer goods have certainly been significant. Could they make the Phillips curve flatten or perhaps even disappear (Poloz 2019)?

Market concentration has been increasing steadily, and inflation behaviour has become more influenced by the pricing behaviour of large retail chains and stores. Larger retailers have more monopoly power than smaller firms. Therefore, they can pursue preferred pricing strategies that make them more competitive and less influenced by economic disturbances. For example, large chains can adopt uniform pricing across stores in different locations (DellaVigna and Gentzkow 2019), vary the incidence of price discounts (Kryvtsov and Vincent 2020), synchronize price changes for many of their products at a time (Bonomo et al. 2020), or obfuscate their pricing by using add-on pricing or quality upgrades (Ellison 2016).

The monopolistic effects in Canada may be somewhat offset by increased retail competition (Friedrich and Gosselin 2015), in particular by the expansion of e-commerce, which currently comprises around 3 percent of retail sales in Canada. Pro-competitive effects of e-commerce lead to lower, more flexible prices (Gorodnichenko and Talavera 2017). Chernoff (2019) presents evidence that Amazon.com's expansion can account for about one-third of the observed reduction in the number of products sold by Canadian online retailers from 1999 to 2012. These effects, however, do not yet seem to be quantitatively important for Canadian inflation (Charbonneau et al. 2017).

Increasingly, retailers are relying on non-price margins to compete. As firms produce more new and better products, consumption baskets undergo a continuous overhaul. Broda and Weinstein (2010) estimate that in a typical year, 40 percent of the basket are goods created in the last four years, and 20 percent are goods that disappear in the next four years. Expansion in varieties leads to fragmentation of household consumption into niches, whereby households increasingly concentrate on buying their most favourite goods and services (Neiman and Vavra 2019). Furthermore, new varieties tend to be oriented to high-income households, which exacerbates inflation inequality between high- and low-income households (Jaravel 2019).

With the vast number of product varieties and widely dispersed tastes across consumers, retailers invest considerable resources in advertising and data collection. Consumption transactions increasingly involve transfers of consumer data to vendors. Retailers that have access to and can aggregate data for many consumers can infer tastes for existing varieties of products, and even for varieties that are yet to be created. This gives them additional competitive power.

All these changes in the marketplace suggest that measured inflation is decoupling from its traditional fundamentals and that a re-evaluation of how prices are measured is needed.<sup>3</sup> Widely adopted price indices, like the CPI, provide the average cost of the fixed consumption basket. Statistical agencies already have methods in place that account for the turnover of product varieties and improvements in the quality of goods (Diewert 2019; Kryvtsov 2016). These methods, however, may need to be revised to account for the rise in niche consumption and the uneven distribution of consumption spending across households. To some degree, differences in prices faced by different

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<sup>3</sup> More broadly, analysis of the inflation process faces challenges measuring the aggregate price index (ILO et al. 2004) and economic slack, such as output gap (Guisinger, Owyang and Shell 2018).

households can be associated with observed demographic characteristics, such as age, household size and income (Kaplan and Schulhofer-Wohl 2017).

A much more challenging task is to identify the effect of data disclosure on prices. Private and social values of agglomerated databases are not yet well understood. Because data are nonrival, they can be used simultaneously by many firms, and agglomeration of data can lead to substantial increasing returns (Jones and Tonetti 2020). In contrast, privacy concerns raise questions about property rights and the organization of markets for data. Theoretical analyses of information disclosure problems underscore their significance in consumers' spending decisions (Ichihashi 2020). Future work will address these issues within frameworks of industry inflation dynamics and price setting.

## 6. Policy lessons and emerging questions

As of the end of 2019, the return of inflation to around 2 percent had not alleviated concerns about a fundamental change in the inflation process. Understanding the reasons behind weak inflation in advanced economies over the last decade may provide clues about what inflation will be going forward.<sup>4</sup>

So far, we know little. Global factors—oil and trade globalization—can explain only a portion of domestic inflation fluctuations. Emerging survey data are demonstrating that inflation expectations of managers and households behave very differently from full-information rational expectations assumed in most policy models. Expansion of randomized control trials reveals that changes in monetary or fiscal policies that operate via inflation expectations may lead to unexpected outcomes. The transformation of consumer-good markets along with the expansion of new product varieties and a dramatic shift to big data methods by large retailers raises the need to rethink the methods for measuring inflation.

These observations bring up the following questions for central bankers:

First, is monetary policy far less stimulative than we realize? A weaker expectations channel of monetary policy could explain why much of the recent literature finds only small quantitative effects of quantitative easing and some types of forward guidance by central banks (Bernanke, Kiley and Roberts 2019; Ehrmann et al. 2019; Eberly, Stock and Write 2020). The stimulative power of the other game in town—fiscal policy—is also the subject of ongoing debate, although there is some evidence that fiscal multipliers are stronger when interest rates are at the effective lower bound (Miyamoto, Nguyen and Sergeyev 2018).

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<sup>4</sup> The literature discussing recent inflation dynamics is vast and active. Examples of other themes in this research agenda include studies of the flattening of the price Phillips curve (Del Negro et al. 2020), the flattening of the wage Phillips curve (Gali and Gambetti 2019), the decrease in the pass-through from wage changes to price changes (Heise, Karahan and Sahin 2020), fiscal determinants of inflation (Andolfatto and Spewak 2018), identification of the Phillips curve (McLeay and Tenreyro 2019), secular stagnation (Eggertsson, Mehrotra and Robbins 2019), supply-side determinants of inflation (Hobijn 2019), population aging and labour force composition (Fujita and Fujiwara 2016), response of prices to high uncertainty (Ilut, Valchev and Vincent 2020) and the nexus between inflation and credit (Gilchrist et al. 2017).

Second, do policy frameworks that rely on expectations as a policy instrument need to be re-evaluated? Indeed, inflation expectations of many individual households and firms are not reflective of what the central bank does. And when their expectations do change, their decisions may depend on economic contexts that we do not yet fully understand. In this light, comparisons of alternative monetary policy frameworks may yield different answers when they more fully account for the actual behaviour of expectations (Coibion et al. 2020). For example, raising the inflation target to increase the buffer with the binding effective lower bound may not be a good idea if inflation expectations fail to adjust quickly. Reifschneider and Wilcox (2020) argue that sluggish inflation expectations may limit the central bank's ability to bring inflation back to target.

Third, can central bank communication be more effective? Stark differences between expectations of financial professionals and those of non-financial managers and households suggest that a layered approach to communication could be more effective. Reaching a population that is generally uninformed about what central banks do may require central banks to use new means of communication, such as blogs and social media, that reach a broad audience. These communications are also more likely to be influential if they use simple and relatable messaging.<sup>5</sup>

Fourth, are traditional measures of inflation becoming less accurate? The expansion of e-commerce, the rise of niche consumption and the shift of retail to data-driven sales and marketing strategies warrant expanding both data and methods to improve the accuracy of price measurement (Reinsdorf and Schreyer 2019). Price data should provide more detail about the appearance of new and the obsolescence of old goods and services, and they need to capture the differences in pricing across retailers (large versus small, brick-and-mortar versus online). Spending data should scope the changes in the composition of the consumption basket across demographic groups and be updated more frequently than once a year.

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<sup>5</sup> For example, as part of their Inflation Targeting Campaign 2019, the Bank of Jamaica issued [music videos](#) delivered by nationally recognized artists promoting the central bank's goal of low, stable and predictable inflation.

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## Appendix: Notes for Chart 1.<sup>6</sup>

Country	Target	Core inflation
US	-Dual mandate of price stability and maximum sustainable employment -Price stability has been defined since Jan 2012 as 2% y/y PCE inflation <a href="https://www.federalreserve.gov/newsevents/pressreleases/monetary20120125c.htm">https://www.federalreserve.gov/newsevents/pressreleases/monetary20120125c.htm</a>	Different regional Feds construct alternative measures of underlying inflation (e.g. the Dallas Fed trimmed mean). However, to the best of my knowledge none of these are 'official' measures, so for simplicity we usually report core PCE (i.e. PCE ex food and energy), which is the measure included in the Summary of Economic Projections
EA	The ECB's Governing Council adopted a quantitative definition of price stability in 1998: "Price stability is defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%." The Governing Council clarified in 2003 that in the pursuit of price stability it aims to maintain inflation rates below, but close to, 2% over the medium term. <a href="https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html">https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html</a>	A range of underlying inflation measures are typically monitoring by the ECB (including exclusion measures, trimmed mean, weighted median, etc). Of these, no single measure or set of measures appears to be the preferred measure. In INT, we typically track EA core inflation with HICP ex food/energy/alcohol/tobacco, given its use by the ECB in speeches, etc. <a href="https://www.ecb.europa.eu/pub/economic-bulletin/articles/2018/html/ecb.ebart201804_03.en.html#toc3">https://www.ecb.europa.eu/pub/economic-bulletin/articles/2018/html/ecb.ebart201804_03.en.html#toc3</a>
Japan	-The Bank of Japan set the "price stability target" at 2 percent in terms of the year-on-year rate of change in the consumer price index (CPI) in January 2013. -In 2009, the BoJ defined price stability as "In a positive range of 2 percent or lower, and the midpoints of most Policy Board members' 'understanding' are around 1 percent." Further detail was provided in Feb 2012. <a href="https://www.boj.or.jp/en/announcements/release_2013/k130122b.pdf">https://www.boj.or.jp/en/announcements/release_2013/k130122b.pdf</a> <a href="https://www.bis.org/publ/work647.pdf">https://www.bis.org/publ/work647.pdf</a> (Appendix I)	-The Bank of Japan's Research and Statistics Department releases four estimates in line with the monthly release of the official CPI for Japan (the diffusion index of increasing/decreasing items; the trimmed mean; the mode; and the weighted median). -To the best of our knowledge, however, none of these is an 'official' core measure. In practise, analysis of Japanese core inflation often uses the 'Western core' measure (which excludes food, non-alcoholic beverages, and energy), which is broadly comparable to the exclusion measures used in other AEs <a href="https://www.boj.or.jp/en/research/research_data/cpi/index.htm/">https://www.boj.or.jp/en/research/research_data/cpi/index.htm/</a>
Sweden	-In Sept 2017, the Riksbank adopted inflation measured in terms of the CPIF (the consumer price index with a fixed interest rate) as a formal target variable for monetary policy. The target for monetary policy is that the annual change in the CPIF shall be 2 per cent, that is, the same level previously applied to the CPI. The Riksbank will also use a variation band of 1-3 per cent -At the time of the announcement, the Governor noted that "These changes will not affect the monetary policy conducted. In practice, the CPIF has been the Riksbank's operational target variable for several years" <a href="https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/press-releases/2017/cpif-target-variable-for-monetary-policy/">https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/press-releases/2017/cpif-target-variable-for-monetary-policy/</a> -Previously, the tolerance band initially introduced around the 2% target in 1993 had been abolished in 2010. <a href="https://www.bis.org/review/r151229e.pdf">https://www.bis.org/review/r151229e.pdf</a>	-A number of measures of underlying inflation are regularly published in the Monetary Policy Report (CPIF excluding energy, CPIF excluding energy and perishable goods, Trim85, Trim1, UND24, KPIFPV, KPIFPC*). These are often shown as a band in which the measure showing the highest and lowest rate of increase respectively for each month constitutes the band's upper and lower limit. *CPIF and CPIF excluding energy are published by the national statistics agency. The other core measures in this list are published by the Riksbank itself. <a href="https://www.riksbank.se/en-gb/statistics/macro-indicators/underlying-inflation/">https://www.riksbank.se/en-gb/statistics/macro-indicators/underlying-inflation/</a>
UK	-The Government sets the BoE an inflation target of 2%. If the Consumer Prices Index (CPI) inflation rate is more than 3% or less than 1%, the Governor writes a letter to the Chancellor to explain why and they set out what the BoE will do to get it back to 2%. <a href="https://www.bankofengland.co.uk/monetary-policy/inflation">https://www.bankofengland.co.uk/monetary-policy/inflation</a> -The 2% CPI target replaced the 2.5% RPIX target in 2003 <a href="https://www.bankofengland.co.uk/-/media/boe/files/letter/2003/chancellor-letter-annex-101203.pdf">https://www.bankofengland.co.uk/-/media/boe/files/letter/2003/chancellor-letter-annex-101203.pdf</a>	-The BoE monitors various measures but does not appear to have a preferred measure. In INT, we typically track the measure that excludes food, energy, tobacco, and alcohol.
Aus	-"Australia's inflation target is to keep annual consumer price inflation between 2 and 3 per cent, on average, over time. The particular measure of consumer price inflation is the percentage change in the Consumer Price Index (CPI)." <a href="https://www.rba.gov.au/education/resources/explainers/australias-inflation-target.html">https://www.rba.gov.au/education/resources/explainers/australias-inflation-target.html</a>	-"In Australia, the most important indicators of underlying inflation are the trimmed mean and the weighted median (see Box: Calculating the Trimmed Mean and the Weighted Median). The ABS also calculates the CPI excluding volatile items, which is the average inflation rate of all items in the CPI basket except for fruit, vegetables and fuel." These three measures are regularly published on the RBA's website. <a href="https://www.rba.gov.au/education/resources/explainers/inflation-and-its-measurement.html">https://www.rba.gov.au/education/resources/explainers/inflation-and-its-measurement.html</a>
NZ	-In 2002, the target was narrowed to 1 to 3 percent inflation over the medium term. Finally, in 2012 an explicit focus was given to the 2 percent mid-point of the 1 to 3 percent range <a href="https://www.rbnz.govt.nz/monetary-policy/history-of-policy-targets-agreements">https://www.rbnz.govt.nz/monetary-policy/history-of-policy-targets-agreements</a> -"The new Policy Targets Agreement takes effect on 26 September, when Mr Wheeler starts his five-year term as Governor. The agreement continues to require the Reserve Bank to keep CPI inflation between 1 per cent and 3 per cent on average over the medium term. Within this target, the new agreement now requires the Bank to focus on keeping future average inflation near 2 per cent." <a href="https://www.rbnz.govt.nz/news/2012/09/news-release-announcing-2012-policy-targets-agreement">https://www.rbnz.govt.nz/news/2012/09/news-release-announcing-2012-policy-targets-agreement</a>	-There are several underlying inflation measures tracked by the RBNZ. The most recent pre-Covid Monetary Policy Statements (MPR equivalent) reported 5 measures (sectoral factor model, 30% trimmed mean, ex food and energy, weighted median, and core factor model). -So far I have not been able to get data on the trimmed mean and weighted median measures that is both up to date and comparable over the entire time period (the data from the last MPS is available but does not include recent quarters, while updated series do not cover the whole period due to changes in weights, and I have not had the time to figure out how to combine them). Since earlier MPS documents appear to have highlighted the sectoral factor model measure in particular, I have included this as the core measure for now. -NZ had a GST increase in 2010, the effects of which show up in the headline series included in the chart. The tax impact could be removed from the headline series, if you prefer; this would be more consistent with the approach taken for Japan. (Unlike Japan, however, an 'ex tax' version of the series does not appear to be directly available from the source, so we would have to do the calculation ourselves.)

<sup>6</sup> We thank Kristina Hess for providing these notes.