BANK OF CANADA
BANQUE DU CANADA

Staff Analytical Note/Note analytique du personnel—2023-3

Last updated: February 27, 2023

Firms' inflation expectations and price-setting behaviour in Canada: Evidence from a business survey

by Ramisha Asghar, James Fudurich and Jane Voll

Canadian Economic Analysis Department
Bank of Canada, Ottawa, Ontario, Canada K1A 0G9
rasghar@bankofcanada.ca, jfudurich@bankofcanada.ca, jvoll@bankofcanada.ca

DOI: https://doi.org/10.34989/san-2023-3 | **ISSN** 2369-9639

Acknowledgements

The authors would like to thank Yeo Eun Chi for research assistance. Colleagues Tony Chernis, Farrukh Suvankulov, Joshua Slive and Mark Baker provided valuable comments and suggestions. Economists in the Survey and Economic Intelligence Division conducted the underlying field research, and interview partners provided insights into business processes and decisions during Business Outlook Survey interviews. The results are the authors' own.

Introduction

Economic conditions affect prices, and the behaviour of prices plays a role in the effectiveness of monetary policy. When prices adjust slowly, prolonged monetary policy measures may be needed to manage inflation. This is because monetary policy takes time to be transmitted through the economy and affect prices. High inflation expectations that become entrenched may delay the transmission of monetary policy such that measures are more aggressive or in place longer than would be conventionally expected.

Implementing effective monetary policy could be more challenging for central banks if firms expect inflation to be high. Tightening monetary policy slows price growth by reducing overall demand, slowing cost increases and raising competitive pressure on firms. But high inflation expectations may encourage large price increases if firms believe that cost growth will remain high after a tightening of monetary policy. If left unchecked, high inflation and elevated inflation expectations could cause a wage-price spiral, anchoring high inflation with harmful economic consequences.[1] Because of this risk, understanding whether high inflation expectations are influencing firms' price-setting behaviour is critical to know for an inflation-targeting central bank.

We investigate whether the recent period of high inflation has changed how Canadian firms set prices for their products and services. Firms note that during periods of low and stable inflation, their input prices and the degree of competition for their output are the two most important factors in setting prices.[2] For example, an increase in prices for inputs often motivates firms to raise their output prices, but the extent to which these increases are passed through to the customer is tempered by competitive pressures in the marketplace and the risk of irritating customers. We look for evidence of whether firms' high expectations for inflation are now influencing their price-setting decisions.

We use evidence from the Bank of Canada's Business Outlook Survey (BOS) to assess the price-setting behaviour of firms. The BOS collects structured survey responses as well as feedback from in-depth discussions with around 100 business leaders each quarter.[3] Combining both types of information give us a holistic view of price-setting decisions, motivations and reasoning.

We find little evidence that firms' price setting is directly based on high inflation expectations. However, we find that widespread growth in input prices during a period of strong customer demand and reduced competition may have contributed to price increases that were larger than usual. This may explain some of the inflationary pressure observed in 2021 and early 2022. Furthermore, early evidence suggests that in the second half of 2022, price-setting behaviour was gradually returning to pre-pandemic practices, supporting a path for inflation

[1] For more information on the wage-price spiral, see Bank of Canada (2022a).
[2] See Amirault, Kwan and Wilkinson (2005).
[3] See Amirault, Rai and Martin (2020) for a reference guide to the Business Outlook Survey.

to return to the inflation-control target range.[4] However, the risk remains that high inflation may start to be reflected directly in output prices, which would make it more difficult for monetary policy to reduce inflation.

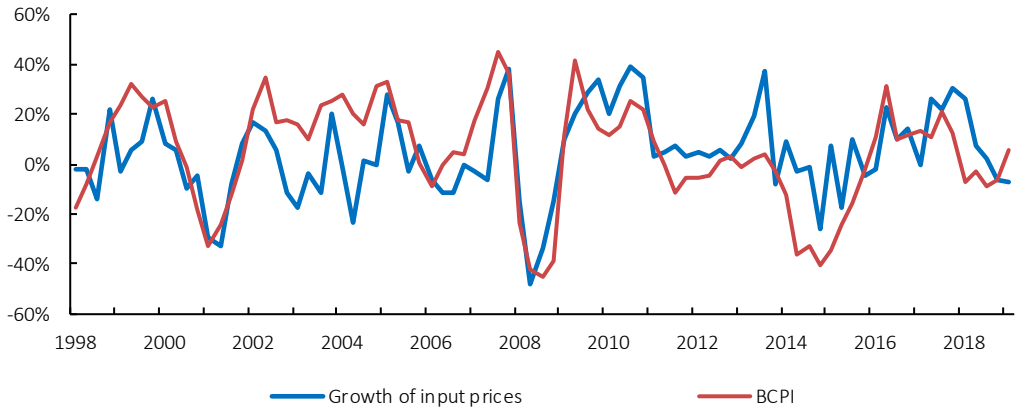
The pre-pandemic relationship between costs, prices and inflation expectations

In this section, we use BOS data from the third quarter of 1998 through to the end of 2019 to examine how closely firms' survey responses about costs, prices and inflation expectations match other macroeconomic data for the same period. We then determine which factors are most strongly related to output prices during this pre-pandemic period.

Changes in firms' reported costs reflect movements in macroeconomic data

We first compare firms' assessments of the input price environment with changes in other measures of economy-wide input prices. In the BOS, the Bank asks firms to compare their expected growth in labour costs (wages) and non-labour costs (input prices) in the next 12 months with that of the past 12 months.[5] We find that, when shifted ahead one quarter, the balance of opinion measured by the BOS on growth of non-labour input prices moves somewhat in line with the Bank of Canada commodity price index (**Chart 1**).

Chart 1: Firms' expected growth of input prices is moderately correlated with the Bank of Canada commodity price index



Source: Bank of Canada

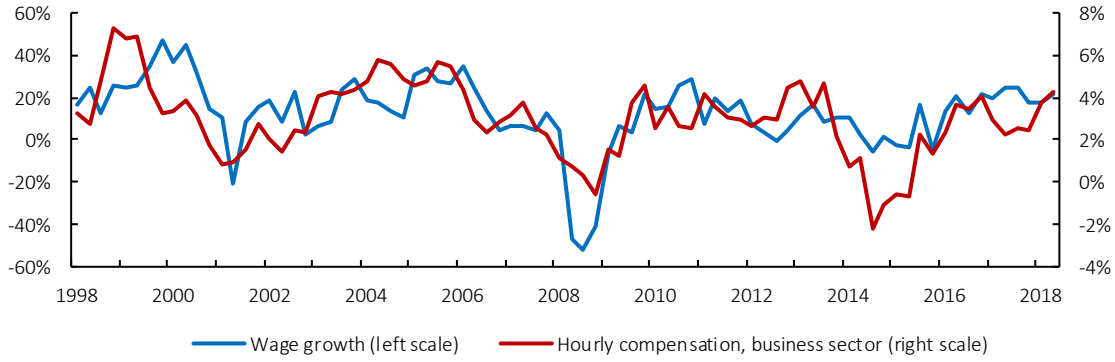
Last observations: Business Outlook Survey, 2019Q3; BCPI, 2019Q4

Note: *Growth of input prices* is the balance of opinion on input price growth from the Business Outlook Survey, shifted one quarter ahead. *BCPI* is the year-over-year percentage change in the Bank of Canada commodity price index.

[4] See the *Business Outlook Survey—Third Quarter of 2022* and *Business Outlook Survey—Fourth Quarter of 2022* for a summary of results from the second half of 2022.

[5] See Amirault, Rai and Martin (2020) for more details about the questions and balance of opinion calculations in the Business Outlook Survey.

Chart 2: Firms' expected wage growth also shows a moderate correlation with business sector compensation



Sources: Statistics Canada and Bank of Canada

Last observations: Business Outlook Survey, 2018Q4; Statistics Canada, 2019Q4

Note: *Wage growth* is the balance of opinion on expected increases in labour costs from the Business Outlook Survey, shifted four quarters ahead. *Hourly compensation, business sector* is the year-over-year percentage change in Statistics Canada's index of business sector total compensation per hour worked.

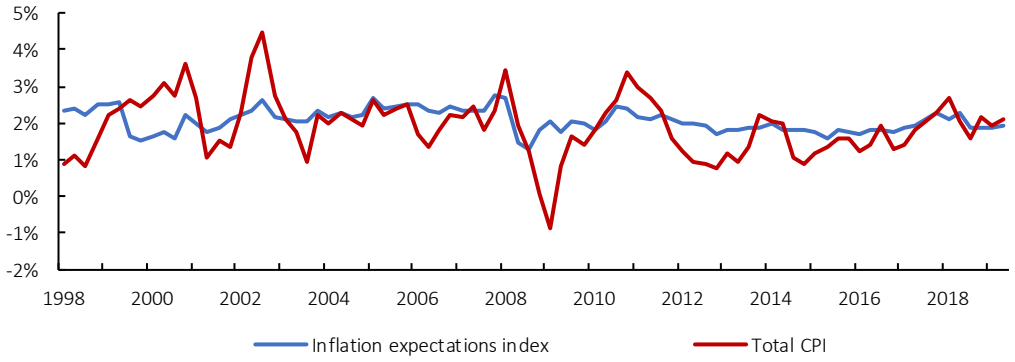
This implies that firms in the BOS sample anticipate growth in commodity prices one quarter in advance. The balance of opinion in the BOS on wage pressures moves most closely with the Statistics Canada measure of hourly compensation (with a correlation of 0.58) when the BOS measure for wage growth is shifted four quarters ahead (**Chart 2**). Thus, movements in the BOS measures for expected growth in wages and input prices show moderately strong correlation with those of their respective comparative measures.

Firms' inflation expectations are a weak indicator of actual inflation

BOS firms are asked what they expect average year-over-year growth in the consumer price index (CPI) to be over the next two years (**Chart 3**). We then compare those expectations with total CPI, a measure of actual inflation. We find that, before the pandemic, firms' inflation expectations reported in the BOS do not correlate well with actual inflation in the same time period (a correlation of 0.40).[6]

[6] Before the fourth quarter of 2010, the Bank used the inflation expectations index (IEI) to calculate an implied median estimate of inflation based on firms' responses to a BOS question about inflation expectations over the next two years (see page 38 in Amirault, Rai and Martin 2020). Since the fourth quarter of 2010, the IEI has been calculated by averaging firms' point estimates for inflation over the next two years, using midpoint estimates from categorical responses when point estimates are unavailable.

Chart 3: Correlation between firms' expectations for inflation and consumer price index is fairly weak



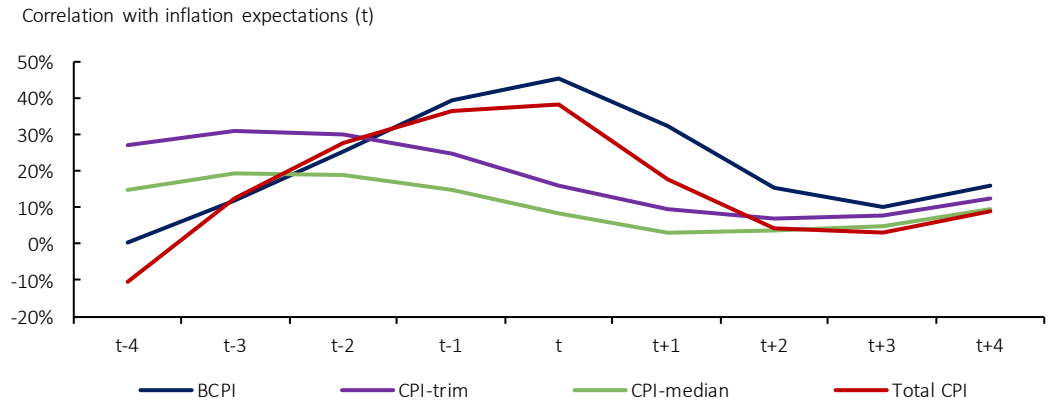
Sources: Statistics Canada and Bank of Canada

Last observation: 2019Q4

Note: *Inflation expectations index* is the average two-year inflation expectations from firms in the Business Outlook Survey. *Total CPI* is the consumer price index and shows the year-over-year percentage change (unadjusted).

This suggests that firms were using other information not reflected in the total CPI measure when setting their own inflation expectations. In fact, we find that overall, different measures of inflation—such as CPI-median or CPI-trim—are weak indicators of firms' inflation expectations (**Chart 4**).[7] This finding is consistent with previous results that suggest firms' inflation expectations in the BOS do not accurately predict average headline inflation over the next two years.[8]

Chart 4: Firms' inflation expectations and other measures of inflation have a moderately weak correlation at different time horizons



Sources: Statistics Canada and Bank of Canada

Last observation: 2019Q4

Note: *BCPI* is Bank of Canada commodity price index and *Total CPI* is consumer price index. *CPI-trim* excludes the most extreme (high and low) price changes each month. *CPI-median* represents the midpoint of the distribution of monthly price changes. *t* represents the contemporaneous correlation with the inflation expectations index.

[7] See Bank of Canada (2022b).

[8] For more on inflation expectations in the BOS, see Richards and Verstraete (2016).

Firms' costs are a key driver of their selling prices

Firms' expectations for growth in input prices and wages are strongly related to their expectations for growth in output prices (**Table 1**). This suggests that firms' expectations for cost growth are an important driver of their expectations for output prices. In contrast, the correlation between inflation expectations and expectations for output prices is weak. Furthermore, changes in wage pressures are more strongly correlated with expectations for input prices than with those for output prices. Therefore, in addition to having a direct effect on output prices from firms' own labour costs, wage pressures may have an indirect effect through the labour costs of input suppliers.

A somewhat stronger relationship exists between inflation expectations and input price pressures (correlation of 0.25) than between inflation expectations and output price pressures (correlation of 0.13). This may reflect the impact of commodity prices on both input prices and inflation expectations. An analysis of quarterly firm-level BOS data from 2001 to 2015 supports this idea, revealing that firms' inflation expectations respond to movements in oil prices.[9]

Table 1: Historically, pressures on firms' input prices strongly correlate with firms' output prices

	Correlation with:			
	Input prices	**Wage pressures**	**Inflation expectations index**	**Total CPI**
Output prices	0.748	0.431	0.129	0.337
Input prices		0.511	0.252	0.404
Wage pressures			0.367	0.565
Inflation expectations index				0.365

Note: Business Outlook Survey data are from 1998Q3 to 2019Q4. *Total CPI* is consumer price index.

These results provide evidence that firms' price-setting behaviour is related to their direct costs, but we find no evidence that inflation expectations play a role. However, this analysis using univariate correlations may miss causal relationships that are more complex. For example, inflation expectations show a stronger correlation with firms' wage growth expectations than with expectations for output price growth. Inflation expectations, then, may influence firms' wage growth expectations, which in turn may indirectly affect firms' price-setting behaviour.[10] We investigate the relationship between inflation expectations and price setting in two ways. First, we analyze the narratives that firms in the BOS use to explain their responses to survey questions. These often include an explicit discussion about causation. The

[9] See Richards and Verstraete (2016).

[10] The link between inflation expectations and price setting is tested in a structural vector autoregressive model (SVAR), described in the **Appendix**.

narratives reinforce the result that overall expectations for inflation are not related to firms' price setting. Second, we use multivariate and time-series analyses to further examine the statistical properties of the data. These results, presented in the **Appendix**, largely confirm the findings presented in this section.

What drove the gap between input and output price pressures during the pandemic?

In this section, we use data observed since the start of the pandemic (from the first quarter of 2020 to the end of 2022). We explore the unusually high balances of opinion on output prices relative to the balances of opinion on input prices, and investigate explanations, including the possibility that firms are now incorporating inflation expectations into price setting.

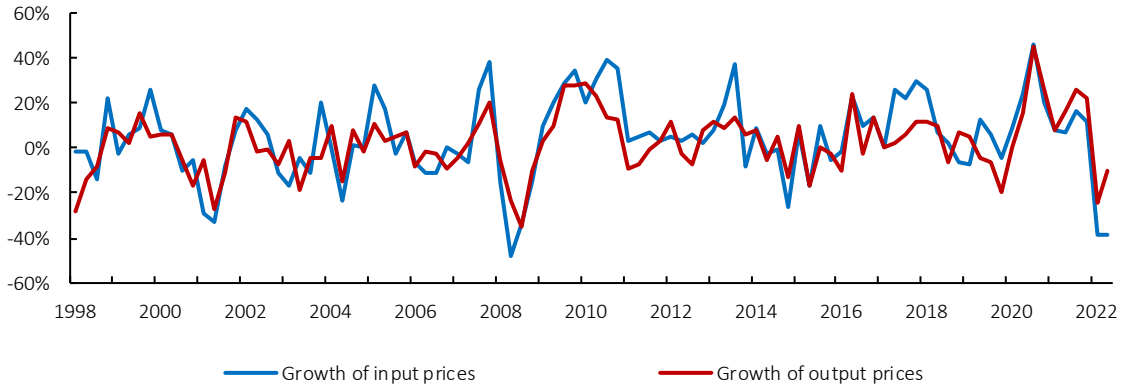
Pressures on output prices have become more widespread than those on input prices

In the BOS, the strong correlation between firms' expectations for input prices and those for output prices suggests that costs are a primary driver of output prices. However, the pass-through from input prices to output prices is rarely instantaneous or complete. In a 2006 Bank survey of price-setting behaviour, firms reported a variety of obstacles to fully passing on their cost increases to customers, including a fear of upsetting customers and a reluctance to adjust prices ahead of competitors.[11] These obstacles are reflected in BOS results for the balance of opinion on output prices. Shifts in the balance of opinion on output prices tend to be less volatile and smaller than changes in the balance of opinion on input prices (**Chart 5**).[12]

[11] In Amirault, Kwan and Wilkinson (2005), of 170 Canadian firms, 61% said they delay price changes if input costs increase.

[12] The historical average of the balance of opinion on input prices is 5%, compared with 2% for output prices. The standard deviation of the input price series is 0.18, compared with 0.14 for output prices.

Chart 5: Firms' outlook for output prices is less volatile than for input prices

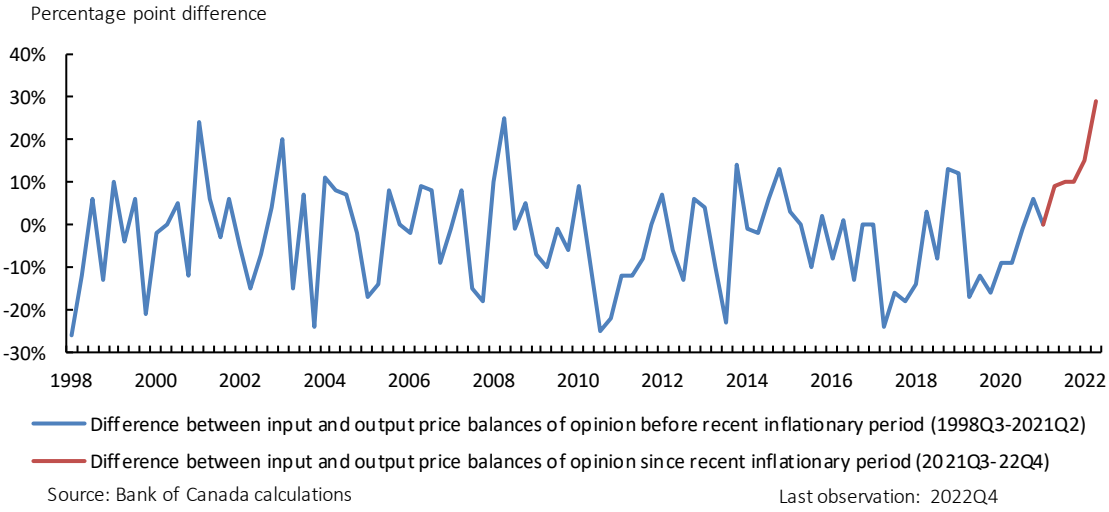


Source: Bank of Canada

Last observation: 2022Q4

Note: *Growth of input prices* and *Growth of output prices* show the balance of opinion of firms in the Business Outlook Survey.

Chart 6: The difference in firms' balance of opinion for increases in input and output prices is mostly negative



Source: Bank of Canada calculations

Last observation: 2022Q4

Note: *Input price growth* and *Output price growth* show the balance of opinion of firms in the Business Outlook Survey.

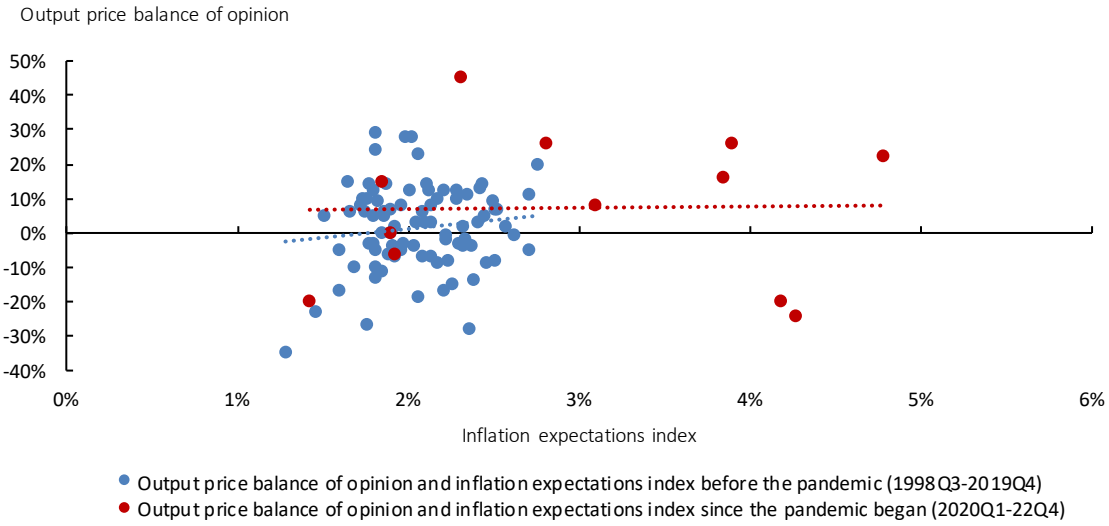
Firms have historically experienced changes in input prices more frequently than changes in output prices. This partly reflects the range of management strategies that can be used to avoid raising output prices if input prices increase. However, changes in output prices appear to have been more widely reported than changes in input prices since the second quarter of 2021 (**Chart 6**). This suggests the pass-through of higher expected input prices to output prices is more widespread than observed before the pandemic. Focusing on the period since the first quarter of 2020, we investigate whether the historical relationship between input

prices and output prices has changed, and whether inflation expectations may explain this growing gap.

Costs remain the top drivers of price setting during the pandemic

Recently, reports of increasing output prices have become more widespread than those of rising input prices among firms surveyed for the BOS. One possible explanation for this is that businesses' near-term inflation expectations—which have been elevated since mid-2021—are now having a direct effect on price setting. Firms, anticipating that inflation will remain persistently high, may be raising their output prices in advance, by more than the expected increase in input prices alone. If true, this could represent a new environment for price setting that could weaken the transmission of monetary policy.

Chart 7: The relationship between firms' inflation expectations and output price pressures has softened during the pandemic



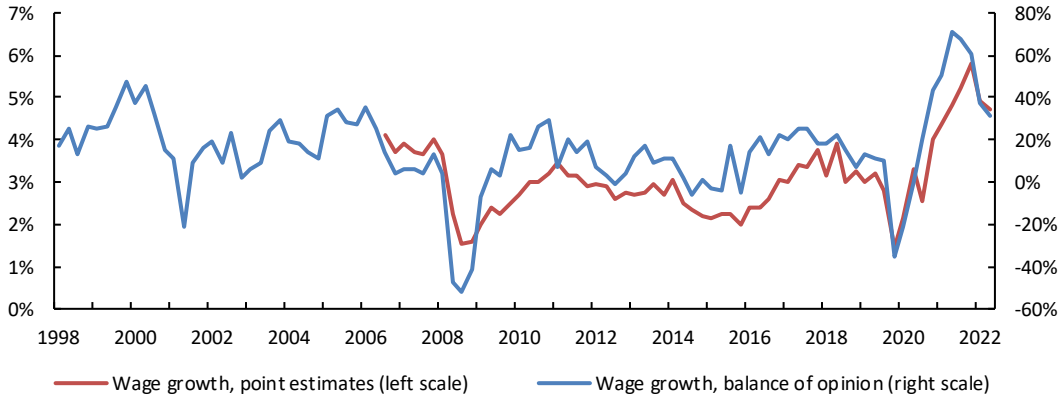
Source: Bank of Canada calculations Last observation: 2022Q4

Note: The dotted lines represent linear trends capturing the correlation between the inflation expectations index and output price balance of opinion for each quarter of the Business Outlook Survey before the COVID-19 pandemic (blue) and since the COVID-19 pandemic began (red).

We investigate this possibility by first examining whether the relationship between firms' expectations for inflation and for growth in output prices has changed since the pandemic began in the first quarter of 2020. We find that inflation expectations continue to have a weak relationship with firms' output prices (see **Table A-3** in the Appendix). Further, we find this relationship has in fact weakened somewhat during the pandemic, as indicated by a flatter slope between the observations in red in **Chart 7**. We find no evidence that high inflation expectations are contributing to more widespread growth in output prices.

Because the relationship between inflation expectations and price setting remains weak, we explore other factors that could be causing increases in output prices to be more widespread than increases in input prices in the current economic environment. One explanation is that firms' expectations for wage growth, a separate indicator from expectations for input price growth, have recently increased to survey highs and may be pushing firms to raise their output prices. BOS estimates of wage growth reveal widespread and large increases in wages that have reached survey highs (**Chart 8**). Furthermore, recent BOS results show that firms are more frequently passing on labour cost increases to output prices compared with the pre-pandemic period of 2014–19 (**Chart 9**).[13] This explanation fits well with our theoretical understanding that firms set prices based on costs, and wages are an important cost. In this case, widespread and high growth in labour costs may be setting the conditions for widespread and high growth in output prices.

Chart 8: Wage pressures are historically widespread and strong



Source: Bank of Canada

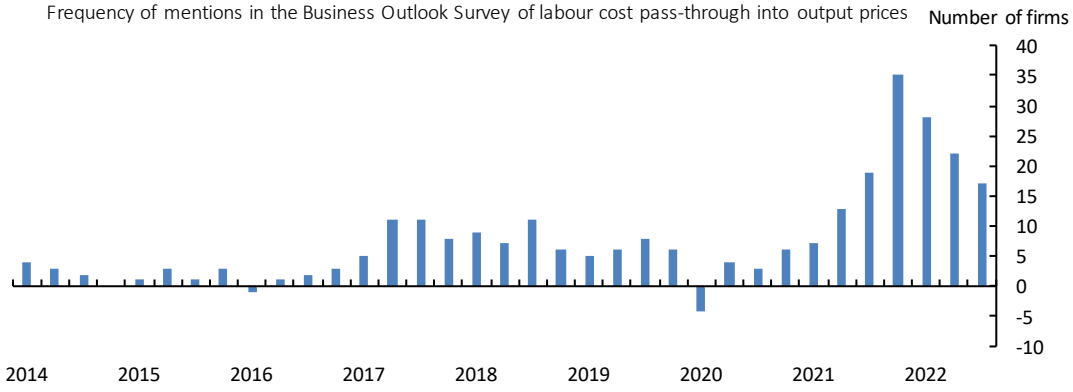
Last observation: 2022Q4

Note: *Wage growth, point estimates* represent the average point-estimate of firms' expected wage growth estimate from the Business Outlook Survey. For more information, see the backgrounder on the Business Outlook Survey question on firms' average expected wage increase.

[13] A question about the pass-through of labour costs to output prices was introduced in the BOS in the second quarter of 2014.

Chart 9: Pass-through of labour costs to output prices remains high

Frequency of mentions in the Business Outlook Survey of labour cost pass-through into output prices



Source: Bank of Canada

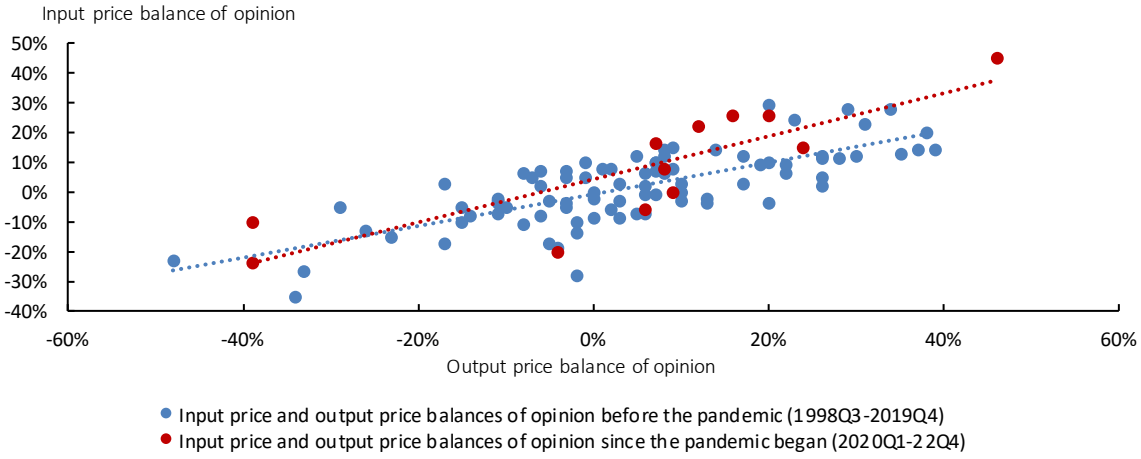
Last observation: 2022Q4

Note: The frequency counts represent the number of firms noting "labour cost pass-through" as a driver of their output price growth.

Another explanation could be that firms are passing through more of their input price increases than in the past. An unusual feature of the economic recovery phase of the pandemic is that demand rose alongside supply chain disruptions, which was noted in BOS results throughout 2021 and in early 2022. Price competition between firms diminished as customers sought a more limited set of products, allowing for unusually large price increases. In addition, firms reported that customers acknowledged the global nature of supply chain disruptions, which likely softened the fear of antagonizing buyers with price increases. Because of these circumstances, firms may have raised their output prices by the same magnitude as—or even beyond that of—the input price increases they experienced.

Indeed, we observe a stronger relationship between expected growth in firms' input prices and expected growth in their output prices since the start of the pandemic, as indicated by the steeper slope of the red dotted line compared with that of the blue dotted line in **Chart 10**. Furthermore, we find the relationship between commodity-driven pressures on input price growth, and the pass-through of those pressures to output prices, to be stronger during the pandemic (**Chart 11**). Thus, as a result of the increase in commodity price pressures throughout the pandemic, more firms have increased their output prices compared with the pre-pandemic trend.

Chart 10: Movements in balances of opinion for input and output price growth have been more similar since the pandemic began

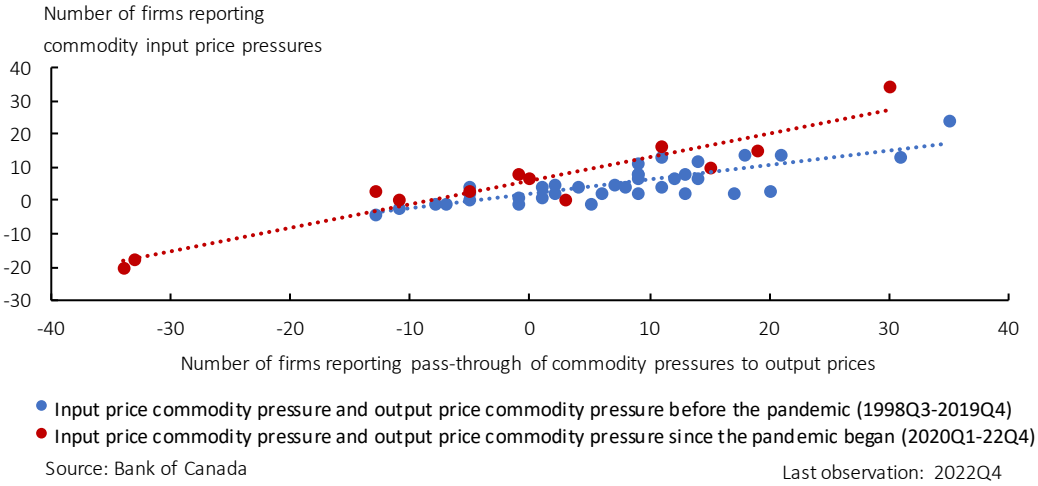


Source: Bank of Canada

Last observation: 2022Q4

Note: The dotted lines represent linear trends capturing the correlation between the input price and output price balances of opinion for each quarter of the Business Outlook Survey before the COVID-19 pandemic (blue) and since the COVID-19 pandemic began (red).

Chart 11: Commodity price pressures are more frequently being passed through to output prices since the pandemic began



Source: Bank of Canada

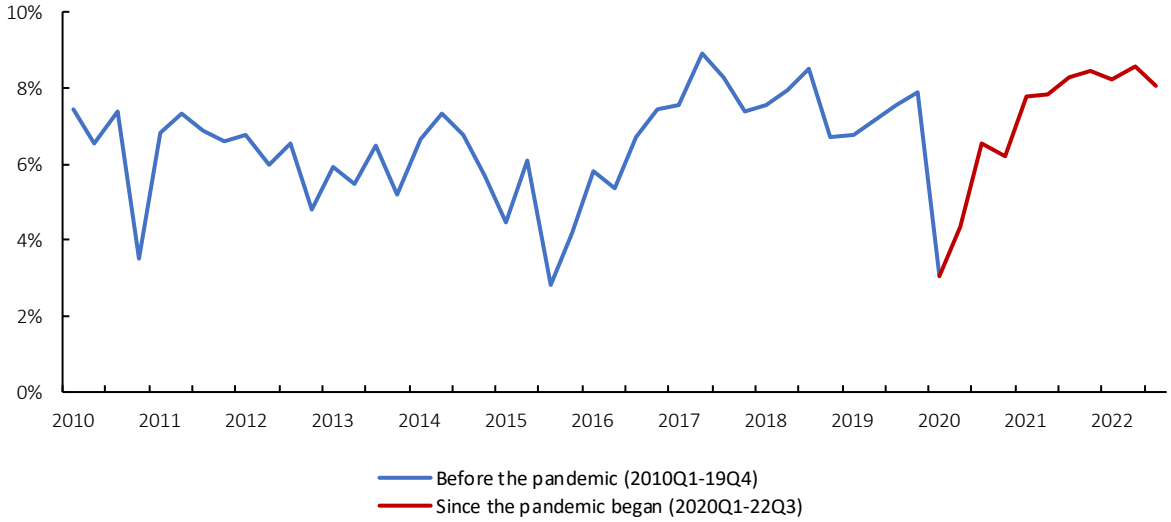
Last observation: 2022Q4

Note: The dotted lines represent linear trends capturing the correlation between firms noting higher commodity price pressures and firms noting higher commodity prices being passed through to output prices for each quarter of the Business Outlook Survey before the COVID-19 pandemic (blue) and since the COVID-19 pandemic began (red).

These measures do not reflect how much of an increase in input prices is passed through to output prices. But with more firms than usual noting an increase in their output prices, the environment for price increases has become more favourable. This is consistent with macroeconomic data showing that, after being squeezed in the first quarter of 2020, profit margins rose gradually during the recovery to eventually surpass the pre-pandemic average (**Chart 12**).

Chart 12: Overall profit margins have risen considerably since early 2020

Net income as a share of revenue, all non-financial industries



Source: Statistics Canada

Last observation: 2022Q3

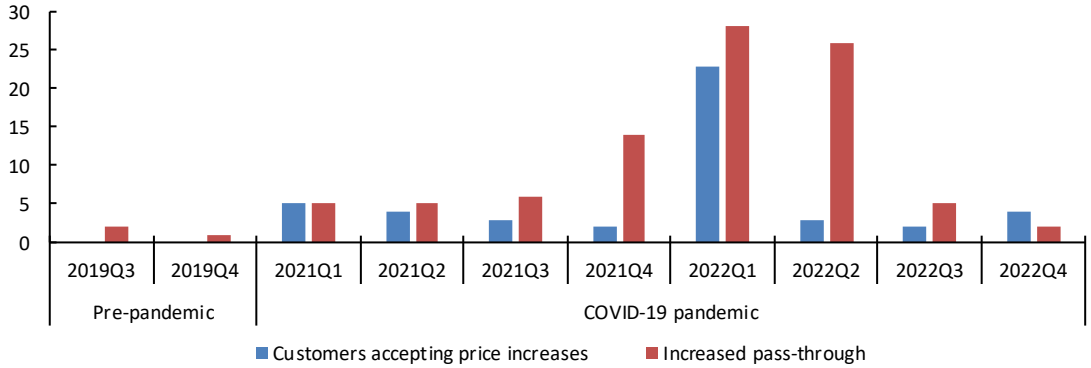
Unusual conditions are supporting more cost pass-through

We also review the narratives firms use to explain their responses to BOS questions on prices and inflation to look for evidence of changes in price-setting behaviour. In particular, we assess whether firms' narratives report unusual price-setting behaviour, such as incorporating high inflation expectations into their price setting or increasing their pass-through of higher input prices to output prices.

We find little evidence that firms are setting prices in anticipation of future cost increases that are tied to their inflation expectations. In fact, in many cases, when firms mention inflation, they are specifically referring to cost increases rather than general inflation. Mentions of general inflation also tend to be vague and are largely separate from discussions of a firm's own experiences with cost increases.

Chart 13: Fewer firms reporting increased pass-through of costs and customer acceptance of price increases

Frequency of narrative mentions in Business Outlook Survey responses



Source: Bank of Canada

Note: Figures represent counts of firms in the Business Outlook Survey mentioning customers being more accepting of price increases or noting greater pass-through of input price increases into output prices than typical in their responses to input and output price pressures.

However, we do observe a notable increase in the number of firms citing more favourable conditions to pass on costs since the start of the pandemic. This includes explicit mentions of more pass-through of input costs to output prices and greater customer acceptance of price increases compared with the pre-pandemic period (**Chart 13**). In the second half of 2022, these factors appear to have declined, and firms' expectations for inflation are starting to ease from the peaks observed earlier in the pandemic recovery.

Conclusion and risks to the inflation outlook

Our results indicate that firms are not currently setting prices based on their expectations for high inflation. Rather, firms raised their output prices due to higher costs and a greater ability to pass these costs on to customers. This suggests that firms' price-setting behaviour remains tied to typical drivers: changes in input prices and the degree of competition.

BOS results for the last two quarters of 2022 indicate that Canadian firms, on balance, expect the growth in output prices to slow. This is consistent with recent declines in commodity prices and fewer reports of customer acceptance of price increases. This also signifies that firms' prices remain flexible and are responding to changing economic conditions—a sign of effective monetary policy transmission. In addition, firms' expectations for inflation have come down, indicating that firms are more optimistic about inflation returning to target than they were in the first half of 2022. As the effects of monetary policy are felt throughout the economy, we expect firms to report a further slowing of output price growth and lower inflation expectations.

However, risks remain that inflation expectations may stay high and could begin to influence price setting, delaying inflation's return to target. The longer inflation remains above target, the greater the likelihood that firms may eventually embed high inflation expectations into their price setting. This may reduce price flexibility, making the path to restore inflation to target longer and more costly. Furthermore, firms' estimates in the BOS for wage growth remain high, indicating that pressures are widespread. Continued, widespread pressure on wages may force firms to increase prices, supporting high inflation and fuelling stronger wage growth in the future to preserve real wages. This cycle could generate a wage-price spiral with adverse economic consequences that would require even stronger monetary policy measures. We monitor these risks closely in our consultation with firms, and we will continue to publicly report our results.

Appendix

Statistical support for causality and importance of inflation expectations in firm price setting

Granger causality test

To assess whether a causal relation exists between output prices and changes in firms' costs or inflation expectations, we use the Granger causality test (**Table A-1**). We find evidence that changes in firms' expectations for input prices and for inflation Granger-cause output price changes at the 10% significance level. Most notably, wage growth and inflation expectations are Granger-causing output price pressures to change at the 5% level, while growth of input prices appears to Granger-cause output price growth at the 10% level.

However, this may be because wage growth and inflation expectations appear to Granger-cause growth in input prices. As we noted in the main paper, commodity prices (such as oil prices) are a statistically significant driver of firms' inflation expectations, and the Bank of Canada commodity price index has a moderately strong correlation with the Business Outlook Survey's (BOS) balance of opinion on input prices. We also noted that the balance of opinion on wage growth is more strongly correlated with growth in input prices than growth in output prices. These results could indicate that a shift in the balance of opinion on input prices may have less of an impact on output prices, after accounting for changes in commodity prices (through inflation expectations) and in wage growth expectations.

Table A-1: Inflation expectations and wage growth Granger-cause growth in input prices

Equation	Excluded	Chi-squared	Degrees of freedom	Prob > Chi-squared
Input prices	Output prices	4.8667	2	0.088
Input prices	Wage pressures	5.6875	2	0.058*
Input prices	Inflation expectations index	13.76	2	0.001***
Input prices	ALL	21.93	6	0.001***
Output prices	Input prices	4.8624	2	0.088*

Output prices	Wage pressures	7.0309	2	0.030**
Output prices	Inflation expectations index	6.7429	2	0.034**
Output prices	ALL	19.567	6	0.003***
Wage pressures	Input prices	2.2748	2	0.321
Wage pressures	Output prices	3.1269	2	0.209
Wage pressures	Inflation expectations index	4.0043	2	0.135
Wage pressures	ALL	13.977	6	0.030**
Inflation expectations index	Input prices	2.0958	2	0.351
Inflation expectations index	Output prices	0.0213	2	0.989
Inflation expectations index	Wage pressures	1.2565	2	0.534
Inflation expectations index	ALL	6.6541	6	0.354

Note: We removed seasonality from the Business Outlook Survey indicators using first differences because they were non-stationary (for more than one lag) based on the unit root test. The timeline for the time series is: 1998Q3–2022Q3. Statistical significance:

Ordinary least squares model for estimating pressure on output prices

Our results show that firms' expectations for costs and inflation Granger-cause growth in output prices. Thus, we construct an ordinary least squares (OLS) model to confirm whether these variables (cost and inflation expectations) are significant when firms set output prices. In our model, we include time-variant fixed effects for 100 observations from the third quarter

of 1998 to the third quarter of 2022. Our baseline specification for determining whether firms' inflation expectations have influenced their price-setting behaviour is:

$$y_t = \beta_0 + \beta_1 \theta_t + \beta_2 \mu_t + \beta_3 \alpha_t + \varepsilon_t, \quad (1)$$

where, θ_t is firms' inflation expectations indicator at time *t*; μ_t is firms' input price pressures at time *t*; α_t is firms' wage pressures; and ε_t is the error term.

Results from our model (see equation 1) suggest that as input price pressures become more or less widespread (i.e., a change in the balance of opinion), firms also adjust selling prices, though adjustments are less widespread. More specifically, before the pandemic, a 1% increase in firms' balance of opinion for input prices causes the balance of opinion for output prices to increase by 0.33% (**Table A-2**, column (1)). This effect has increased since the start of the pandemic (**Table A-2**, column (3)). Additionally, by including time-variant fixed effects in the model, we find a minor increase in the magnitude of this effect. However, our model shows that firms' price-setting behaviour is not influenced by their inflation expectations, unlike our findings in the Granger causality test. Since the pandemic began, the effect of wage growth on the growth of firms' output prices has remained the same but with higher levels of significance (**Table A-2**, column (3)).

Table A-2: Ordinary least squares results suggest input prices are a key driver of output prices both before and after the start of the pandemic

	(1)	(2)	(3)	(4)
Variable	Before the pandemic	Before the pandemic, including fixed effects	After the pandemic began	After the pandemic began, including fixed effects
Input price pressures	0.330***	0.320***	0.409***	0.392***
	(0.0805)	(0.0942)	(0.0729)	(0.0891)
Wage growth	0.229*	0.209	0.229**	0.227*
	(0.116)	(0.147)	(0.103)	(0.132)
Inflation expectations indicator	-2.507	-3.336	-1.517	-1.000
	(5.434)	(6.494)	(4.605)	(5.851)
Constant	0.00227	0.000778	0.00182	0.000384
	(0.0121)	(0.0136)	(0.0115)	(0.0129)
Observations	85	84	96	95
R-squared	0.306	0.356	0.397	0.439

Time fixed effects	No	Yes	No	Yes

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

We further decompose our results across different industries and find that changes in output prices are strongest in response to changes in input prices for trade and manufacturing industries. Wage growth has strong effects on the price-setting behaviour of firms in the commercial, personal and business services (CPBS) sector and the finance, insurance and real estate sector. Additionally, in contrast to our overall results presented in **Table A-2**, we find that inflation expectations influence the price-setting decisions of firms in the CPBS and primary sectors (**Table A-7**, columns (2) and (5)).[14]

Structural vector autoregression model of firms' output prices

Using a structural vector autoregression (SVAR) model, we examine the effect of inflation expectations on firms' price-setting behaviour. We present our results using the impulse response function and variance decomposition to see the relationships between our key BOS indicators: output prices, input prices, inflation expectations and wage pressures. In the SVAR, we treat gasoline prices (base year at 2002) as an exogenous shock. In this exercise, we are interested in the effects of the surge in inflation that took place during the pandemic, which was largely due to the rapid rise in commodity prices, specifically in energy prices. Thus, the exogenous shock in the model closely reflects the high inflationary environment of 2022. Our endogenous variables are pressures on firms' input prices, their inflation expectations, wage pressures and output prices. These variables are consistent with those presented in our OLS equation. The purpose of this exercise is to further examine the validity of our OLS results. The SVAR uses a lag length of one quarter, based on the results from the Hannan–Quinn information criterion.

The reduced form of the SVAR is as follows:

$$\boldsymbol{Y_t = A_1 Y_1 + \epsilon_t},$$

where

$$\boldsymbol{Y_t} = \begin{bmatrix} \boldsymbol{Gasoline\ prices_t} \\ \boldsymbol{IP_t} \\ \boldsymbol{IEI_t} \\ \boldsymbol{Wages_t} \\ \boldsymbol{OP_t} \end{bmatrix}.$$

For the SVAR, our identification method of recursive ordering is based on our interpretation of the link between the BOS indicators, which is supported by firms' narratives. To provide context for the links among BOS indicators, we looked exclusively at BOS narratives from economic cycles that experienced a surge in commodity prices. For this reason, we focused

[14] The primary sector is comprised of firms in agricultural and extractive industries (i.e., mining, oil and gas). Firms in these industries are classified under North American Industry Classification System (NAICS) codes 11 and 21.

specifically on the time periods of 2007Q4, 2008Q1, 2021Q2, and 2021Q3. In the narratives of firms' inflation expectations from these periods, firms mentioned the rise in raw materials and commodity price pressures as reasons for high inflation expectations. We associated pressures on input prices, which are strongly influenced by fluctuations in commodity prices, as drivers of firms' inflation expectations. Additionally, when discussing the drivers of wage pressures, most firms across the sample mentioned inflation, high demand for labour and cost-of-living adjustments. Finally, in firms' narratives about pressures on output prices after the pandemic started, businesses repeatedly mentioned labour shortages and rising demand for labour as key contributors to the pass-through of wages to firms' output prices. Additionally, the pent-up demand from consumers permitted the pass-through of rising commodity prices to firms' output prices. Based on this, we find the link between the BOS indicators to be as follows:

$$\boldsymbol{IP_t \rightarrow IEI_t \rightarrow Wages_t \rightarrow OP_t.}$$

In our SVAR, the Cholesky decomposition is calculated as follows:

$$\begin{bmatrix} \in_{Gas} \\ \in_{IP} \\ \in_{IEI} \\ \in_{Wages} \\ \in_{OP} \end{bmatrix} = \begin{bmatrix} a & 0 & 0 & 0 & 0 \\ b & e & 0 & 0 & 0 \\ c & f & h & 0 & 0 \\ d & g & i & k & 0 \\ e & h & j & l & m \end{bmatrix} \begin{bmatrix} \omega_{Gas} \\ \omega_{IP} \\ \omega_{IEI} \\ \omega_{Wages} \\ \omega_{OP} \end{bmatrix}$$

From this, we assume that $\in_{OP}$ endogenously responds to contemporaneous movement in oil prices. We believe this a fair assumption, given that the information is from firms' narratives about their price-setting behaviour after oil prices surged in 2021. Firms increasingly mentioned passing through commodity price increases in their narratives about output prices, suggesting an endogenous response to fluctuations in the price of oil.

The results of impulse response functions (**Chart A-1**) suggest that that in response to a decline in wage pressures, firms reduce their inflation expectations and slightly increase their prices within two quarters. Firms' prices then decline within two additional quarters. Prices and inflation expectations then stabilize at lower levels. We also find that wage pressures fluctuate the most in response to inflation expectations and output prices, with the impact of the latter declining after two quarters before tapering off. In line with the historical data, firms' growth in output prices declines slightly in response to pressures on input prices within two quarters and remains at a lower level thereafter. The effects of wage pressures and inflation expectations on firms' output prices offset each other, with an increase in output price growth from wage pressures cancelling out a decline in output price growth from firms' inflation expectations. The variance decomposition presented in **Table A-9** further solidifies these findings, suggesting that changes in input price pressures account for most of the variation in firms' output prices, and that this impact diminishes over time. Differences in firms' inflation expectations have the smallest impact on the variance in firms' output prices.

Appendix tables

Table A-3: Historical relationships between output prices and input prices have strengthened since the start of the pandemic

Correlations (1998Q3–2022Q4)	Input prices	Wage pressures	Inflation expectations index	Total CPI
Output prices	0.761	0.450	0.165	0.101
Input prices		0.36	-0.001	-0.079
Wage pressures			0.599	0.608
Inflation expectations index				0.803

Note: Business Outlook Survey data are from 1998Q3 to 2022Q4. *Total CPI* is consumer price index.

Table A-4: Global pandemic strengthened the relationship between firms' output prices and input prices

Correlations (2020Q1–2022Q4)	Input prices	Wage pressures	Inflation expectations index	Total CPI
Output prices	0.843	0.432	0.065	-0.028
Input prices		0.001	-0.421	-0.498
Wage pressures			0.826	0.802
Inflation expectations index				0.983

Note: Business Outlook Survey data are from 2020Q1 to 2022Q4. *Total CPI* is consumer price index.

Table A-5: Granger causality results: A one-quarter lag shows simultaneity bias between wage growth and input prices

Equation	Excluded	Chi-squared	Degrees of freedom	Prob > Chi-squared
Input prices	Output prices	0.26186	1	0.609
Input prices	Wage pressures	2.9558	1	0.086*
Input prices	Inflation expectations index	8.4228	1	0.004***
Input prices	ALL	8.8473	3	0.031**
Output prices	Input prices	6.5398	1	0.011**
Output prices	Wage pressures	5.6329	1	0.018**
Output prices	Inflation expectations index	5.4401	3	0.020**
Output prices	ALL	15.16	3	0.002***
Wage pressures	Input prices	4.5075	1	0.034**
Wage pressures	Output prices	0.1796	1	0.672
Wage pressures	Inflation expectations index	2.2e-0.5	1	0.996
Wage pressures	ALL	5.076	3	0.166

Inflation expectations index	Input prices	2.4334	1	0.119
Inflation expectations index	Output prices	0.00142	1	0.970
Inflation expectations index	Wage pressures	0.00102	1	0.975
Inflation expectations index	ALL	3.6125	3	0.306

Note: We removed seasonality from the *Business Outlook Survey* indicators using first differences since they were non-stationary (for more than one-lag) based on the unit root test. The timeline for the time series is: 1998Q3–2022Q3. Statistical significance: * 10% level, ** 5% level, *** 1% level.

Table A-6 Granger causality results: A three-quarter lag shows simultaneity bias between inflation expectations and input costs

Equation	Excluded	Chi-squared	Degrees of freedom	Prob > Chi-squared
Input prices	Output prices	6.4073	3	0.093
Input prices	Wage pressures	7.8633	3	0.049**
Input prices	Inflation expectations index	12.113	3	0.007***
Input prices	ALL	24.771	9	0.003***
Output prices	Input prices	7.863	3	0.049**
Output prices	Wage pressures	10.873	3	0.012**

Output prices	Inflation expectations index	6.8474	3	0.077*
Output prices	ALL	29.692	9	0.000***
Wage pressures	Input prices	3.6547	3	0.301
Wage pressures	Output prices	3.9714	3	0.265
Wage pressures	Inflation expectations index	4.0813	3	0.253
Wage pressures	ALL	15.238	9	0.085*
Inflation expectations index	Input prices	14.74	3	0.002***
Inflation expectations index	Output prices	0.93876	3	0.816
Inflation expectations index	Wage pressures	3.9024	3	0.272
Inflation expectations index	ALL	20.317	9	0.016**

Note: We removed seasonality from the *Business Outlook Survey* indicators using first differences since they were non-stationary (for more than one-lag) based on the unit root test. The timeline for the time series is: 1998Q3–2022Q3. Statistical significance: * 10% level, ** 5% level, *** 1% level.

Table A-7: Granger causality results: A four-quarter lag shows simultaneity bias between inflation expectations and input prices as well as input prices not Granger-causing output prices

Equation	Excluded	Chi-squared	Degrees of freedom	Prob > Chi-squared
Input prices	Output prices	5.6702	4	0.225
Input prices	Wage pressures	10.412	4	0.034**
Input prices	Inflation expectations index	9.6898	4	0.046**
Input prices	ALL	28.758	12	0.004***
Output prices	Input prices	7.1693	4	0.127
Output prices	Wage pressures	13.214	4	0.010***
Output prices	Inflation expectations index	5.7258	4	0.221
Output prices	ALL	29.932	12	0.003***
Wage pressures	Input prices	4.8935	4	0.298
Wage pressures	Output prices	3.7923	4	0.435
Wage pressures	Inflation expectations index	3.8643	4	0.425
Wage pressures	ALL	15.39	12	0.221

Inflation expectations index	Input prices	13.423	4	0.009***
Inflation expectations index	Output prices	4.2065	4	0.379
Inflation expectations index	Wage pressures	8.7551	4	0.068*
Inflation expectations index	ALL	26.748	12	0.008***

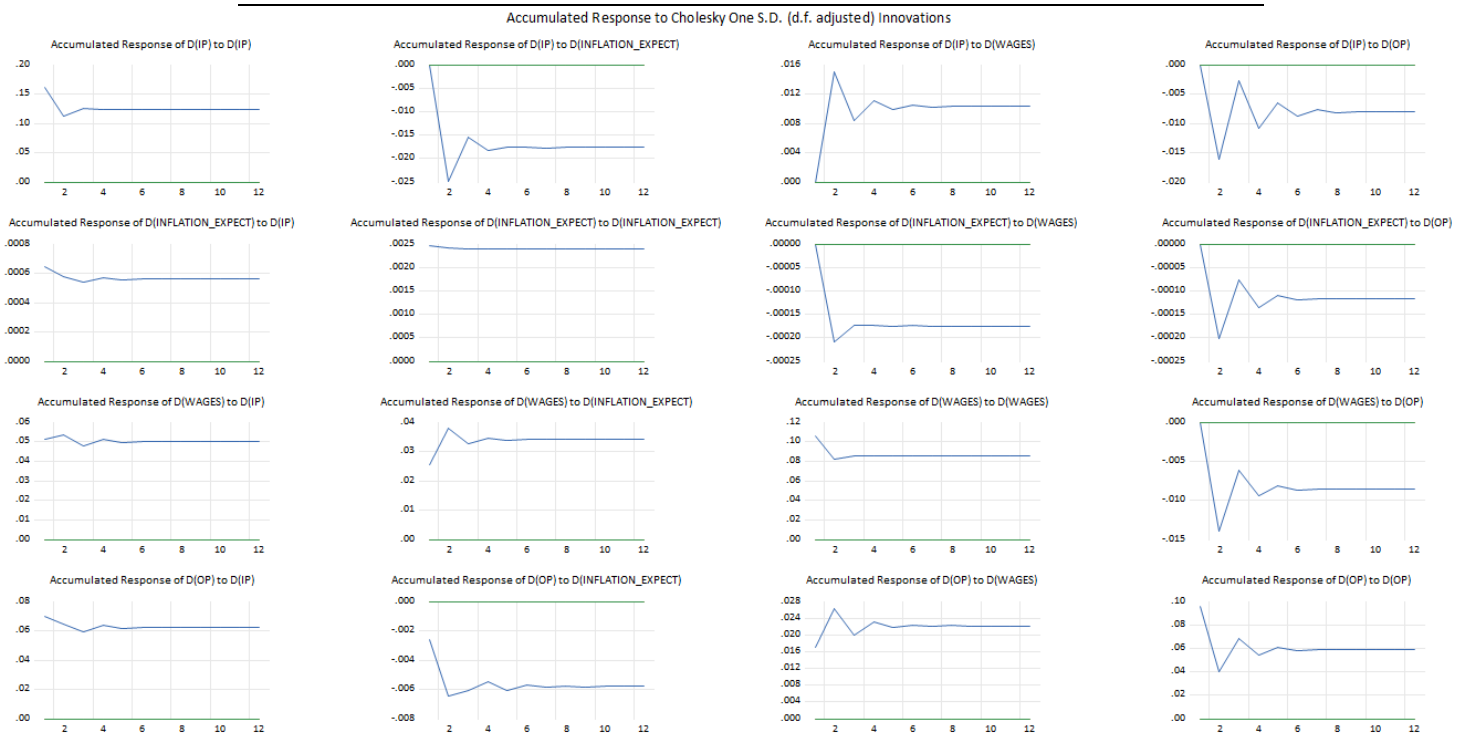
Note: We removed seasonality from the *Business Outlook Survey* indicators using first differences since they were non-stationary (for more than one-lag) based on the unit root test. The timeline for the time series is: 1998Q3–2022Q3. Statistical significance: * 10% level, ** 5% level, *** 1% level.

Table A8: Ordinary least squares results across industries

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	CITU	CPBS	FIRE	Manufacturing	Primary	Trade
Input price pressures	0.231***	-0.041	0.371***	0.541***	0.323***	0.705***
	(0.075)	(0.106)	(0.101)	(0.085)	(0.090)	(0.082)
Wage pressures	0.081	0.380***	0.247***	0.216*	0.141	-0.028
	(0.085)	(0.099)	(0.090)	(0.116)	(0.126)	(0.096)
IEI	-9.257	25.129***	9.071	-0.064	-25.992*	3.485
	(7.376)	(8.137)	(9.344)	(8.998)	(13.766)	(8.122)
Constant	0.006	-0.005	-0.005	0.003	0.005	0.004
	(0.021)	(0.021)	(0.026)	(0.023)	(0.039)	(0.024)
Observations	94	96	96	96	96	96
R-squared	0.120	0.269	0.215	0.342	0.143	0.458
Time fixed effects	No	No	No	No	No	No

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. *IEI* is inflation expectations index, *CITU* is construction, information, transportation and utilities; *CPBS* is commercial, personal and business services; and *FIRE* is finance, insurance and real estate.

Chart A-1: Structural vector autoregressive model results with one-quarter lag



Note: We removed seasonality from the *Business Outlook Survey* indicators using first differences since they were non-stationary (for more than one-lag) based on the unit root test. The timeline for the time series is: 1998Q3–2022Q3. D(OP): First difference in output prices; D(INFLATION_EXPECT): First difference in inflation expectations index; D(WAGES): First difference in wage pressures; and D(IP): First difference in input prices.

Table A-9: Variance decomposition using Cholesky factors

Variance decomposition of D(INFLATION_EXPECT):					
Period	S.E.	D(IP)	D(INFLATION_EXPECT)	D(WAGES)	D(OP)
1	0.002560	6.427159	93.57284	0.000000	0.000000
2	0.002577	6.408240	92.32688	0.659473	0.605407
3	0.002581	6.415906	92.06979	0.677027	0.837276
4	0.002582	6.428256	92.00675	0.676530	0.888467
5	0.002582	6.431834	91.99381	0.676562	0.897797
6	0.002582	6.432598	91.99147	0.676586	0.899350
7	0.002582	6.432742	91.99107	0.676590	0.899595
8	0.002582	6.432767	91.99101	0.676591	0.899632
9	0.002582	6.432771	91.99100	0.676591	0.899637
10	0.002582	6.432772	91.99100	0.676591	0.899638
11	0.002582	6.432772	91.99100	0.676591	0.899638
12	0.002582	6.432772	91.99100	0.676591	0.899638

Variance decomposition of D(WAGES):

Period	S.E.	D(IP)	D(INFLATION_EXPECT)	D(WAGES)	D(OP)
1	0.120242	18.32668	4.521396	77.15193	0.000000
2	0.123955	17.27710	5.226912	76.23859	1.257389
3	0.124479	17.33756	5.347870	75.68277	1.631806
4	0.124574	17.37263	5.359546	75.56900	1.698824
5	0.124589	17.38005	5.360765	75.55049	1.708695
6	0.124591	17.38130	5.360922	75.54778	1.709999
7	0.124591	17.38149	5.360945	75.54740	1.710156
8	0.124591	17.38152	5.360948	75.54736	1.710174
9	0.124591	17.38153	5.360949	75.54735	1.710175
10	0.124591	17.38153	5.360949	75.54735	1.710176
11	0.124591	17.38153	5.360949	75.54735	1.710176
12	0.124591	17.38153	5.360949	75.54735	1.710176

Variance decomposition of D(OP):

Period	S.E.	D(IP)	D(INFLATION_EXPECT)	D(WAGES)	D(OP)
1	0.119730	33.98367	0.047222	2.011871	63.95724
2	0.132681	27.85128	0.121912	2.142228	69.88458
3	0.135868	26.67975	0.116864	2.261498	70.94188
4	0.136614	26.48912	0.117895	2.287152	71.10584
5	0.136776	26.46284	0.119550	2.291474	71.12613
6	0.136809	26.46006	0.120236	2.292110	71.12760
7	0.136816	26.45993	0.120436	2.292193	71.12744
8	0.136817	26.45998	0.120485	2.292202	71.12734
9	0.136817	26.46000	0.120495	2.292202	71.12731
10	0.136817	26.46000	0.120497	2.292202	71.12730
11	0.136817	26.46000	0.120498	2.292202	71.12730
12	0.136817	26.46000	0.120498	2.292202	71.12730

Cholesky Ordering: D(IP) D(INFLATION_EXPECT) D(WAGES) D(OP)

Note: S.E. is standard error. D(OP): First difference in output prices; D(INFLATION_EXPECT): First difference in inflation expectations index; D(WAGES): First difference in wage pressures; D(IP): First difference in input prices; and D(OP): First different in output prices.

References

Amirault, D., C. Kwan and G. Wilkinson. 2005. "A Survey of the Price-Setting Behaviour of Canadian Companies." *Bank of Canada Review* (Winter 2004–2005): 29–40.

Amirault, D., N. Rai and L. Martin. 2020. "A Reference Guide for the Business Outlook Survey." Bank of Canada Staff Discussion Paper No. 2020-15.

Bank of Canada. 2022a. "Box 3: Scenario with a wage-price spiral." *Monetary Policy Report* (July): 25.

Bank of Canada. 2022b. "Appendix: Measuring core inflation." *Monetary Policy Report* (October): 28–31.

Richards, S. and M. Verstraete. 2016. "Understanding Firms' Inflation Expectations Using the Bank of Canada's Business Outlook Survey." Bank of Canada Staff Working Paper No. 2016-7.