BANK OF CANADA
BANQUE DU CANADA

Staff Analytical Note/Note analytique du personnel—2025-9

Last updated: March 4, 2025

Estimating the inflation risk premium

by Bruno Feunou[1] and Gitanjali Kumar[2]

[1] Financial Markets Department
Bank of Canada
BFeunou@bankofcanada.ca

[2] World Bank
gkumar10@worldbank.org

DOI: https://doi.org/10.34989/san-2025-9 | **ISSN** 2369-9639

Acknowledgements

We thank Jonathan Witmer, Miguel Molico and Stéphane Lavoie for their helpful comments and suggestions on this analysis. We thank Ayesha Siddiqua for excellent research assistance. Finally, we are extremely grateful for excellent editorial assistance from Maren Hansen and Nicole van de Wolfshaar.

Introduction

Canada and other countries have experienced a period of both high inflation and high inflation expectations from early 2021 until the end of 2023. However, there has been a sustained decrease in both inflation and inflation expectations, mostly due to policies central banks have implemented (**Chart 1**). While this decrease is a welcome development, central banks need to monitor whether inflation expectations remain anchored near their inflation-control targets. The inflation risk premium (IRP) embedded in asset prices can help assess whether inflation expectations could become de-anchored.

The IRP is the compensation, or extra returns, investors expect for holding an asset that carries inflation risk. It is a product of the perceived exposure to inflation risk (risk perception) in that asset and the price that investors require to be exposed to that risk (risk aversion). An elevated IRP could:

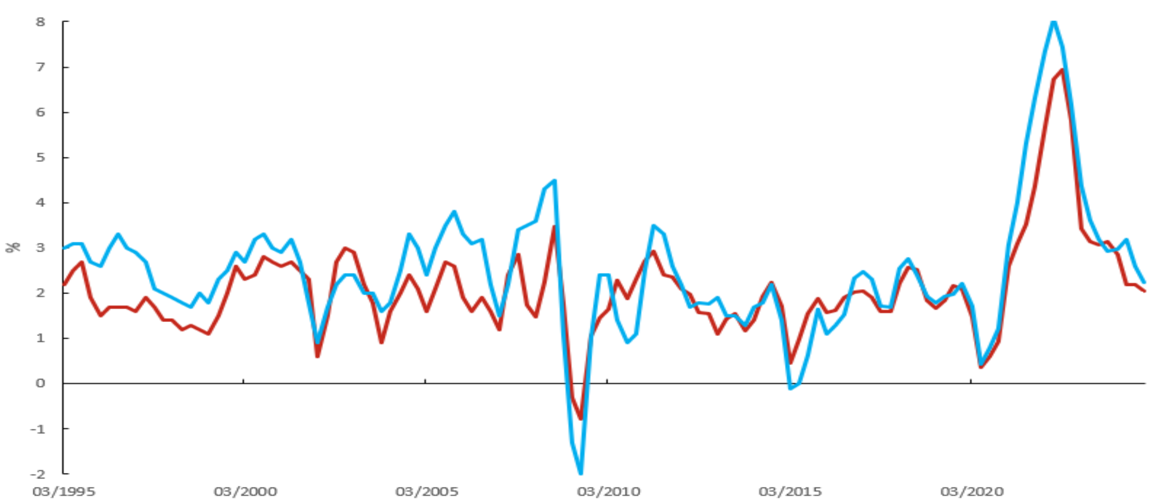
- indicate increased risk perception or risk aversion
- signal a greater risk of inflation expectations becoming de-anchored

Our analysis uses traditional asset pricing models to infer the IRP and its two components: risk perception and risk aversion. Estimates from bond and stock market returns suggest that investors expect higher inflation risk compensation than they did before the COVID-19 pandemic. This appears to be more true in the United States than it is in Canada. This increase in the demand for compensation suggests a higher risk of de-anchoring of inflation expectations than in the past.

The increase can be attributed largely to a rise in perceived risk in both countries. This elevated risk perception could indicate a high frequency of inflationary shocks or the inability of investors to fully hedge inflation risk. The IRP has not followed the downward trend in inflation expectations and remains elevated, suggesting that investors remain concerned about the risk of high inflation.

Chart 1: Three-month-ahead inflation forecast

In annual percentage



Sources: Consensus Economics and Bank of Canada calculations

Last observation: December 9, 2024

Framework and empirical findings

Because the IRP and its two components are not directly observable, we estimate them using two simple and popular asset pricing models:

- the capital asset pricing model (CAPM), which relates the premium of any asset to the market risk premium
- the consumption-based capital asset pricing model (CCAPM), which determines the market risk premium as the covariance between consumption growth and the return on the market

In this note, we use the CAPM to assess the perceived quantity of inflation risk and the CCAPM to measure the price of that risk. The product of the two is a proxy for the IRP.

A key result of the CAPM links the premium on any asset to the market risk premium. In particular, the IRP (IRP_t) is the product of the nominal bond beta (β_{π_t}) and the market risk premium (MRP_t). That is,

$$IRP_t = \beta_{\pi_t} * MRP_t,$$

where β_{π_t} is the sensitivity of the real return on a nominal government bond to the real return on the market portfolio.

MRP_t can be determined in many ways. One of the earliest and most popular models is the CCAPM. This model stipulates that the market risk premium is the product of the marginal investor's risk aversion and the covariance between the real return on the market portfolio and the real consumption growth. We rely on the CCAPM to measure MRP_t, although numerous studies and tests highlight its limitations.[1] We provide details on CAPM and CCAPM as well as on the estimation of β_{π_t} and MRP_t in the **Appendix**.

Since our focus is on inflation risk, we consider the Canadian government bond with three months to maturity. This maturity period is equivalent to a one-period nominal bond in which the primary risk for the investor is inflation risk. Longer-maturity bonds embed both inflation and interest rate risk. Using them would require a dynamic setting, which is outside the scope of this note. We are mindful that the premium on the three-month government bond is small, so we focus more on the time-series evolution than on the size of the IRP. Longer-maturity government bonds would have a larger IRP.

Chart 2 shows the estimates of the quantity of inflation risk, β_{π_t}, in the United States and Canada. The estimate for Canada was declining from the mid-1990s until the 2008–09 global financial crisis and was stable thereafter, with a marked rise in 2022. The estimate for the United States was larger and stable other than during crisis periods until 2022, when it rose substantially as actual inflation (quarter over quarter) reached 6%. The larger quantity of risk for the United States suggests a relatively larger exposure of US Treasuries than Canadian government bonds to inflation risk.

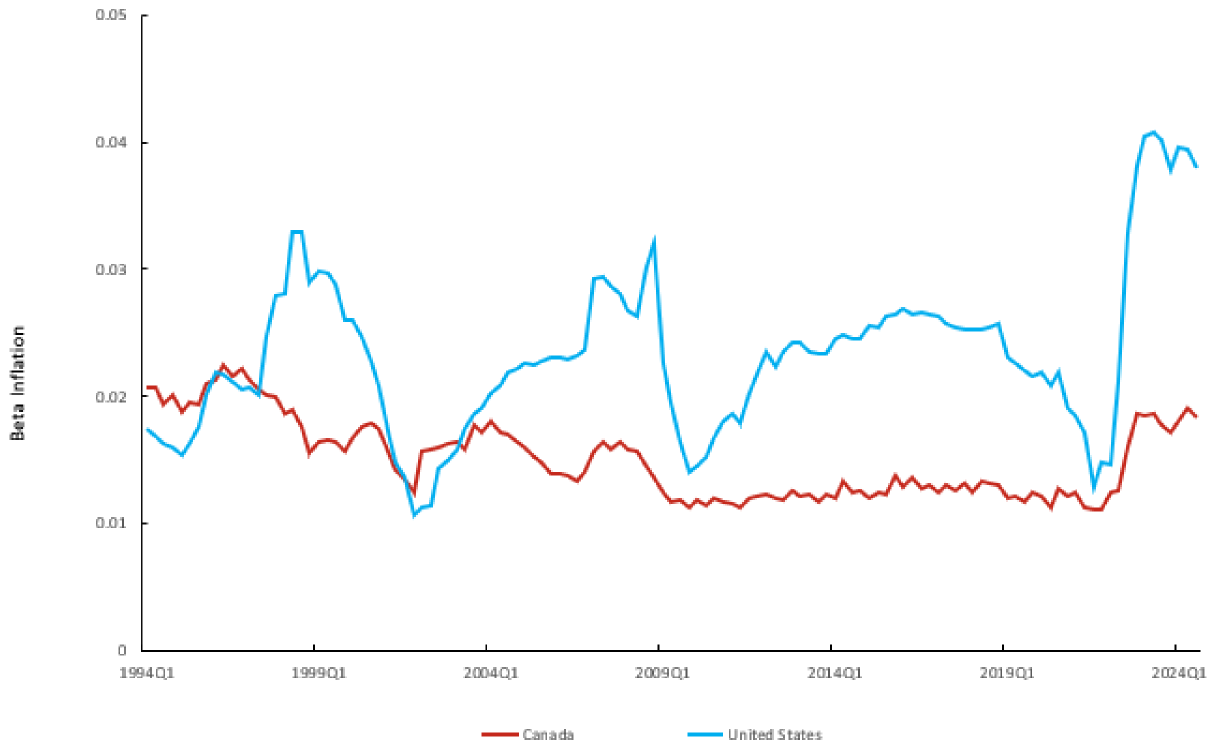
The stability of the quantity of inflation risk in the 2010s is consistent with a period of slow growth and low inflation. Since β_{π_t} is the ratio of the covariance between real returns on government bonds and stocks over the market variance, we check which of these two components is the driving force. We find that

---

[1] The literature categorizes these limitations into three puzzles, the main one being the equity risk premium puzzle. It states that the magnitude of the covariance between the equity returns and consumption growth is not large enough to justify the observed equity premium in equity markets. See R. Mehra, "Consumption-Based Asset Pricing Models," *Annual Review of Financial Economics* 4 (2012): 385–409.

variations in β_{π_t} are almost entirely driven by the covariance between real returns on government bonds and stocks, which is partly influenced by the ability of investors to hedge inflation risk.

Chart 2: Quantity of inflation risk



Note: Beta inflation is the ratio of the covariance between real returns on government bonds and stocks over the market variance.

Sources: Consensus Economics and Bank of Canada calculations

Last observation: 2024Q3

Chart 3 shows the market price of risk, which has been very stable except for periods of crisis, such as the global financial crisis and the COVID-19 crisis. But these deviations were short-lived, and the market price of risk reverted to its long-term average. Over the sample period, the market price of risk is higher in Canada than in the United States, suggesting that, while the inflation risk inherent in US government bonds is greater, the Canadian marginal investor is more risk averse and requires more compensation for the same quantity of inflation risk.

Chart 3: Market price of inflation risk

In annual percentage

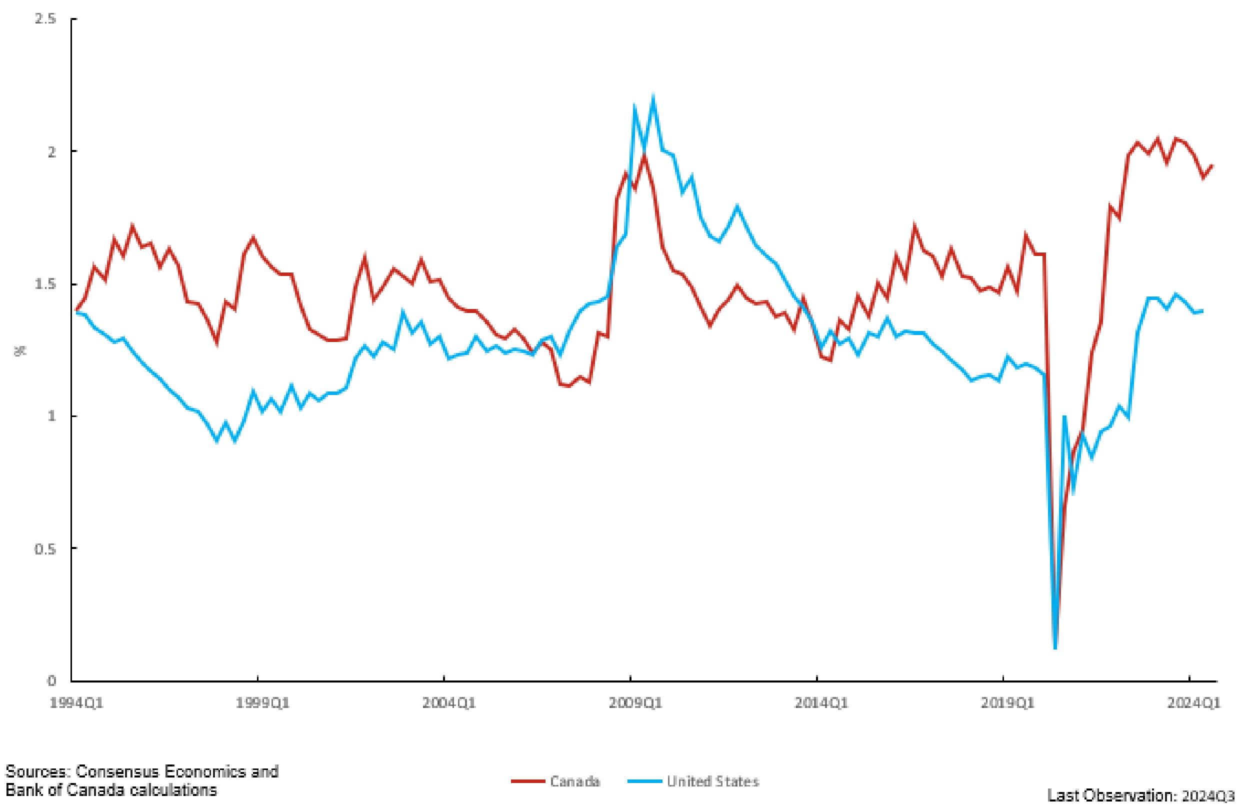


Chart 4 shows the derived IRP, which is a product of the variables shown in **Chart 2** and **Chart 3**. The IRP evolved in a similar fashion for both the United States and Canada up until the COVID-19 crisis. The IRP experienced greater variation for the United States than for Canada during the global financial crisis because:

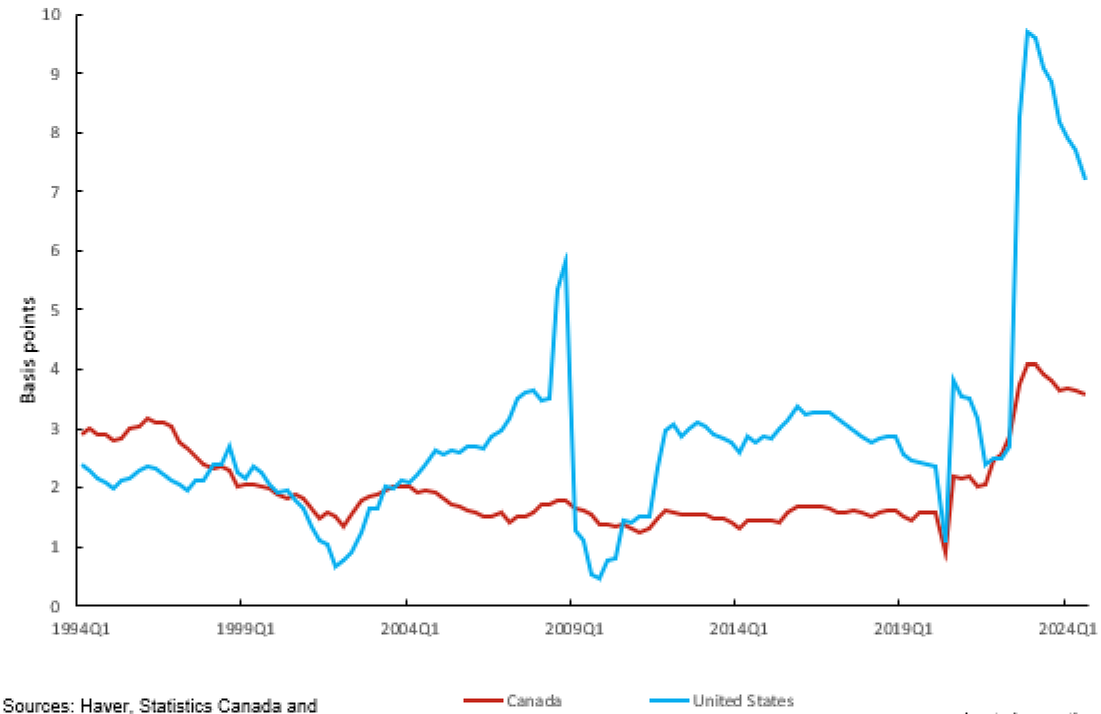
- the Canadian financial system fared better than the US system
- the economic impact in the United States was more profound, which led to relatively larger changes in the quantity of inflation risk

Despite this, the IRP remained stable until 2020. However, since the COVID-19 crisis, the IRP has been markedly higher. Its dynamics were initially influenced by changes in the price of risk. But the IRP rose as the inflation risk rose and is now greater than it was before 2020.

The IRP in the United States is currently higher than it is in Canada. This suggests there is greater risk in the United States of a de-anchoring of inflation expectations, largely driven by increased risk perception.

Chart 4: Inflation risk premium

In basis points



Sources: Haver, Statistics Canada and Bank of Canada calculations

Last observation: 2024Q3

Appendix: Measuring the inflation risk premium (theory)

The set-up assumes a risk-free asset exists and that investors use it to hedge inflation risks. When purchased at time (t) at price B_t^r, it delivers $\frac{CPI_{t+1}}{CPI_t}$ at $t+1$. The real return on this risk-free asset is given by $r_{ft} = -\ln B_t^r$.

A risky asset, whose price is B_t^n at the time of the purchase t, delivers Can$1 at $t+1$. The real return on this risky asset is $R_{t+1}^n = i_t - \pi_{t+1}$, where $i_t = -\ln B_t^n$ is the nominal yield and $\pi_{t+1} = \ln\left(\frac{CPI_{t+1}}{CPI_t}\right)$ is the inflation rate. The expected excess return of this risky asset is the IRP, which we denote by IRP_t.

The capital asset pricing model

The capital asset pricing model (CAPM) implies that

$$IRP_t = \beta_{\pi_t} * MRP_t,$$

where β_{π_t} is the sensitivity of the excess asset return $(R_{t+1}^n - r_{ft})$ to the excess market return $(R_{t+1}^M - r_{ft})$; that is:

$$\beta_{\pi_t} = \frac{CoV_t(R_{t+1}^n, R_{t+1}^M)}{Var_t[R_{t+1}^M]}.$$

And MRP_t is the market risk premium:

$$MRP_t = E_t[R_{t+1}^M] - r_{ft}.$$

β_{π_t} is the perceived quantity of risk inherent in investing in the risky nominal security. MRP_t is the perceived price of risk.

Note that if the market return represents the return on the tangency portfolio in a mean-variance optimization problem (which includes the risk-free asset and the nominal bond), then this implied decomposition of the IRP is always true. [2] However, we do not observe the tangency portfolio, so we use the stock market index as an approximation of the market portfolio.

To evaluate MRP_t, we rely on the consumption-based capital asset pricing model (CCAPM).

The consumption-based capital asset pricing model

The CCAPM stipulates that the market risk premium is the risk aversion (γ) times the covariance between the real consumption growth and return on the market (R_{t+1}^M). That is:

$$MRP_t = \gamma * CoV_t(R_{t+1}^M, \Delta c_{t+1}),$$

where Δc_{t+1} is the quarterly change in the log real consumption growth. In this note, we fix γ = 20.[3]

---

[2] The one-fund theorem in the mean-variance optimization and the CAPM stipulate that every investor will optimally choose to invest in a combination of the risk-free security and a single risky portfolio, i.e., the tangency portfolio.

[3] As is well known, a high parameter value for γ is needed to match the magnitude of the equity risk premium observed in the data.

Estimation

We proxy R_t^M by quarterly returns on the stock market index minus the quarterly change in the consumer price index (CPI). Our proxy for the stock market index is the Toronto Stock Exchange index for Canada and the Standard and Poor's 500 index for the United States.

For the United States, the returns on the risky asset R_t^n are calculated as the difference between the three-month Treasury nominal yield on the previous quarter (*t-1*) and the current quarter (*t*) CPI inflation rate. We do the same for Canada, except we use the three-month Government of Canada nominal yield.

For the United States, we proxy Δc_t by the quarterly change in the personal consumption expenditures price index minus the quarterly change in the CPI. We do the same for Canada, using the change in the household final consumption expenditure.

Using quarterly time-series observations of R_t^n and R_t^M, we rely on a dynamic conditional correlation (DCC) model, a well-known financial econometrics tool to estimate β_{π_t}.[4] Similarly, by using past observed series of R_{t+1}^M and Δc_{t+1}, we again rely on DCC to estimate $CoV_t(R_{t+1}^M, \Delta c_{t+1})$.

[4] Given that $\beta_{\pi_t} = \frac{CoV_t(R_{t+1}^n, R_{t+1}^M)}{Var_t[R_{t+1}^M]}$, we rely on the DCC to estimate the numerator ($CoV_t(R_{t+1}^n, R_{t+1}^M)$) and the denominator ($Var_t[R_{t+1}^M]$). The DCC estimate for $CoV_t(R_{t+1}^n, R_{t+1}^M)$ is like a rolling window covariance between R_t^n and R_t^M, with one important difference: in the rolling windows, all the observations are weighted equally, while the DCC specifies an exponentially decaying weighting function where the most recent observations have greater weight.