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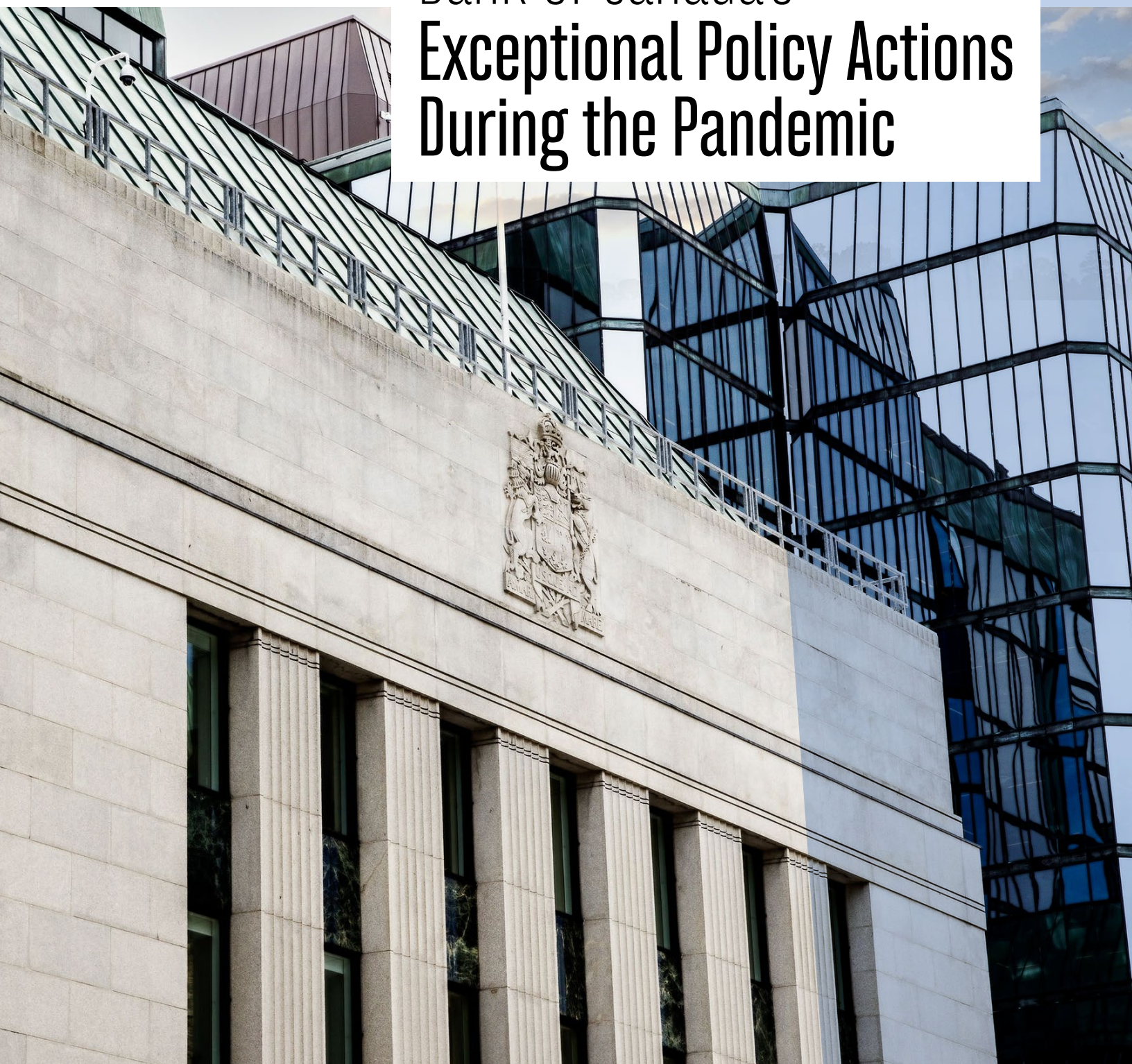
Review of the Bank of Canada's **Exceptional Policy Actions During the Pandemic**



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Executive Summary

The COVID-19 crisis was a once-in-a-lifetime shock that had profound impacts on Canadians and the economy. The extreme uncertainty caused by the crisis led to unprecedented disruptions in financial markets. Measures to curb the spread of the virus saved lives but led to widespread job losses, business closures and financial insecurity across the country.

Governments and central banks around the world took decisive action to prevent economic collapse. In March 2020, the Bank of Canada cut the policy interest rate from 1.75% to 0.25%, and launched a range of liquidity facilities and asset purchase programs to restore market functioning.

By mid-2020, financial markets were working again, but the economy was very weak and inflation was well below target. The Bank turned to two policy tools that are reserved for the most exceptional circumstances: quantitative easing and extraordinary forward guidance. These tools provided additional support, helping steer the economy toward recovery.

This review looks at the effectiveness of the Bank's exceptional policy actions during the pandemic. It also draws several lessons that will help shape future decisions should these tools be needed again.

Evaluating the Bank's bond purchases to restore market functioning

The sudden closure of large parts of the economy in early 2020 created severe shock waves in financial markets. Businesses and investors rushed to sell assets and raise cash because no one knew the consequences of the virus. This generalized flight to the safety of cash froze financial markets. The Bank's top priority was to get markets working again so that households, businesses and governments could continue to access credit.

The Bank launched several programs to stabilize markets by purchasing bonds in financial markets. The largest of these programs involved the purchase of Government of Canada bonds. These bonds serve as the benchmark for other credit markets in Canada. These programs helped restore market functioning quickly, allowing households and businesses to continue to access the credit they needed.

In the future, the Bank could be clearer about the limited circumstances under which it will conduct these kinds of large-scale asset purchases. This would help guard against moral hazard, when market participants take bigger risks thinking the central bank will step in if

things go wrong. Also, the Bank could improve the programs by more clearly distinguishing between asset purchases to restore market functioning and asset purchases for monetary stimulus. The Bank should outline the purpose of each program, and it should design the programs to ensure they are temporary and have a clearly defined exit strategy.

Evaluating the effects of quantitative easing

In June 2020, after markets stabilized, the Bank continued to purchase Government of Canada bonds to provide additional monetary stimulus. This is called quantitative easing (QE). Bond purchases under QE are intended to push down borrowing rates for households and businesses when the policy rate is already as low as it can go. This supports economic growth by encouraging borrowing and spending, and helps the Bank achieve its 2% inflation target.

In October 2021, with the economy on the road to a full recovery, the Bank ended its QE program. Six months later, the Bank began to allow its purchased bonds to mature and roll off its balance sheet—a process called quantitative tightening.

Measuring the precise impact of QE is challenging. The Bank used a variety of approaches to estimate what would have happened without QE. It found the program kept longer-term interest rates lower than they otherwise would have been, thereby boosting the economy and keeping inflation from falling too far below target.

As a result of QE and the bond purchases to restore market functioning, the value of financial assets on the Bank's balance sheet grew significantly. This exposed the Bank to interest rate risk because bond purchases were funded with short-term liabilities that pay interest, called settlement balances. Depending on how interest rates evolved, the Bank could have experienced profits or losses. In this situation, as the Bank raised the policy rate to fight inflation, it saw net losses—as did other central banks that used QE. The Bank expects to return to a positive net income position by 2026, as its balance sheet normalizes, and interest rates decline.

If QE is needed in the future, the Bank could link the size and pace of purchases, as well as the end of QE, more clearly to the inflation outlook.

Because QE supports demand and helps bring inflation back up to the target, some have suggested it contributed to the high inflation that emerged later in the pandemic. However, the Bank's analysis indicates that its policy actions—including QE—did not on their own push inflation significantly above 2%.

Evaluating the effects of extraordinary forward guidance

Extraordinary forward guidance (EFG) signals that the policy interest rate will be low for a defined period or until certain economic conditions are met. This reduces uncertainty about future interest rates and, in doing so, encourages borrowing and spending, which helps

support the economy and bring inflation back to target. The Bank used EFG during the pandemic, saying the policy rate would stay at 0.25% "until economic slack is absorbed so that the 2 percent inflation target is sustainably achieved." It also provided an estimate of the expected timeline, adjusting it as forecasts changed. The Bank officially ended its EFG in January 2022.

When the Bank introduced EFG in July 2020, market interest rates did not move down much because expectations for future rates were already low. Still, EFG may have kept expectations for future rates from rising. Thus, by reducing uncertainty, EFG likely boosted overall demand.

A risk with EFG is that efforts to communicate it as simply as possible can lead markets or the public to interpret it as a broader guarantee than intended. And if a central bank does not follow what it is perceived to have said, it can be accused of breaking its promise. So, if the economy improves faster than expected, a central bank can be forced to choose between ending EFG earlier than was understood or leaving it in place for too long. In the future, the conditions of EFG could be more clearly tied to the inflation outlook and emphasized more often in communications.

The Bank is committed to being transparent—and to learning from the experience of the pandemic. The next crisis could look quite different. Taking on board the lessons outlined in this review will ensure the Bank is better prepared for future crises.

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Review of the Bank of Canada's Exceptional Policy Actions During the Pandemic

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1. Introduction

The COVID-19 pandemic had a profound impact on the lives of Canadians and on the Canadian and global economies. The mandated lockdowns to curb the spread of the virus caused a large share of economic activity to be shut down or scaled back. This saved lives but led to widespread job losses, business closures and financial insecurity for millions of families. Uncertainty about the duration of the health and economic crises also caused unprecedented disruptions in financial markets. The Bank of Canada introduced several extraordinary measures to address these economic and financial shocks. The measures are extraordinary because they are not part of the Bank's usual toolkit and are deployed only in exceptional circumstances.[1]

This report describes the Bank's actions during the pandemic, provides a comprehensive review of their effectiveness, outlines lessons learned and identifies areas for further work to inform future policy. This review is part of the Bank's commitment to Canadians to be transparent and accountable for its policy actions. It is also important that Canadians understand the Bank's actions because monetary policy works better when it is understood and trusted.[2] This report summarizes and builds on previous assessments of the Bank's pandemic-related actions. This includes work done by Bank staff as well as work done by external researchers. It is the first comprehensive review of all the Bank's pandemic-era policies.[3, 4]

This report is organized as follows. Section 2 outlines the evolution of the public health situation and economic environment in Canada during the pandemic period from March 2020 until April 2022. It introduces the Bank's policy actions over this timeline and briefly describes economic developments after the pandemic, including the

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1 This review focuses on the extraordinary measures the Bank employed during the pandemic. The Bank has other measures in its framework for monetary policy at low interest rates (Bank of Canada 2015) that it did not use during the pandemic and that are not discussed in this review. For example, the Bank had previously estimated a theoretical lower bound of -0.50% on its policy interest rate (Witmer and Yang 2016). At the onset of the pandemic, it did not lower rates below 0.25% due to concern about the functioning of the financial system (Poloz 2020). The Bank also did not implement funding for credit programs because similar programs were offered by Export Development Canada and the Business Development Bank of Canada.

2 See Rogers (2022) for a discussion of the importance of trust in achieving the Bank of Canada's objectives.

3 For previous internal assessments of the Bank's responses to the pandemic-related economic shock, see, for example, Arora et al. (2020), Arora et al. (2021), Fernandes and Mueller (2023), Fontaine, Ford and Walton (2020), Fontaine et al. (2021), Johnson (2023), and Gravelle and Wilkins (2021); see Gravelle (2023, 2024) for the impacts of the Bank's programs and market operations on financial markets; see Macklem (2022a, 2022b, 2024) for the impacts on the post-pandemic surge of inflation; and see Kozicki (2024) for the impacts of the Bank's quantitative easing program.

4 Bank staff prepared this report between May and September 2024, and the external reviewers began their assessment in September 2024.

unexpected surge in inflation. Sections 3 to 5 discuss the Bank's response in more detail, with a section addressing each of the Bank's three key measures: section 3 reviews the Bank's asset purchases to address market functioning; section 4 examines quantitative easing for monetary stimulus and the quantitative tightening that followed; and section 5 looks at extraordinary forward guidance. The report explains how these measures were intended to work and assesses their effectiveness. Each of these sections concludes with lessons learned and questions to guide future work and analysis. Finally, section 6 summarizes the key themes and lessons learned from the review.

2. Context and timeline

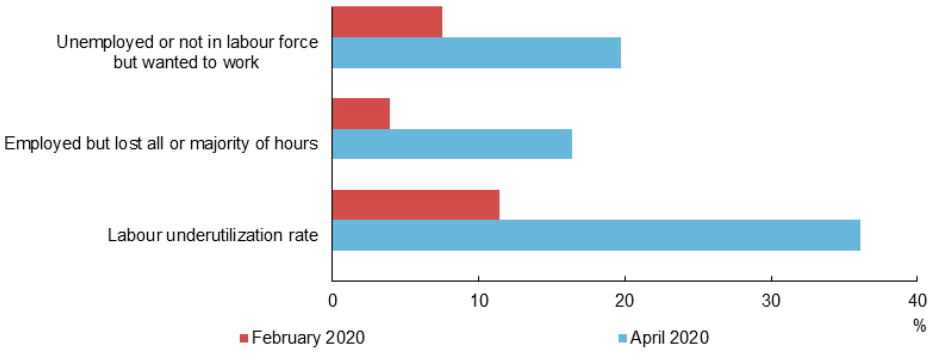
Overview of the pandemic period

The first reported case of COVID-19 in Canada occurred in late January 2020. A handful of cases were reported in Canada throughout February, mostly by international travellers. Then the disease began to spread rapidly. On March 11, the World Health Organization declared COVID-19 a pandemic. By mid-March it was clear that COVID-19 would severely impact people's health and livelihoods and the economy. Workplaces closed because of outbreaks or the fear of outbreaks. Governments in Canada began issuing states of emergency, eventually leading to the implementation of stringent measures to limit public gatherings. These measures included school closures, restrictions on sizes of social gatherings and shutdowns of non-essential businesses, such as restaurants, gyms and non-essential stores.

By the end of March, Canada and countries around the world were under lockdown orders. Many people were unable to work. More than one million jobs were lost in March, and many workers reported working fewer hours (**Chart 1**). By early April, almost 40% of the workforce was without a job or working less than 50% of their regular hours.

Chart 1: Household employment dropped sharply

Monthly labour force data



Note: The labour underutilization rate (a specific definition to measure the impact of the COVID-19 pandemic) is the proportion of people in the potential labour force who either (i) were unemployed, (ii) were not in the labour force but wanted a job and did not look for one, or (iii) remained employed but lost all or the majority of their usual work hours for reasons likely related to the pandemic. The potential labour force (a specific definition to measure the impact of the COVID-19 pandemic) includes people in the labour force (all employed and unemployed individuals) as well as those not in the labour force who wanted a job but didn't search for one for reasons such as "waiting for recall (to former job)," "waiting for replies from employers," "believes no work available (in area, or suited to skills)," "long-term future start," and "other."

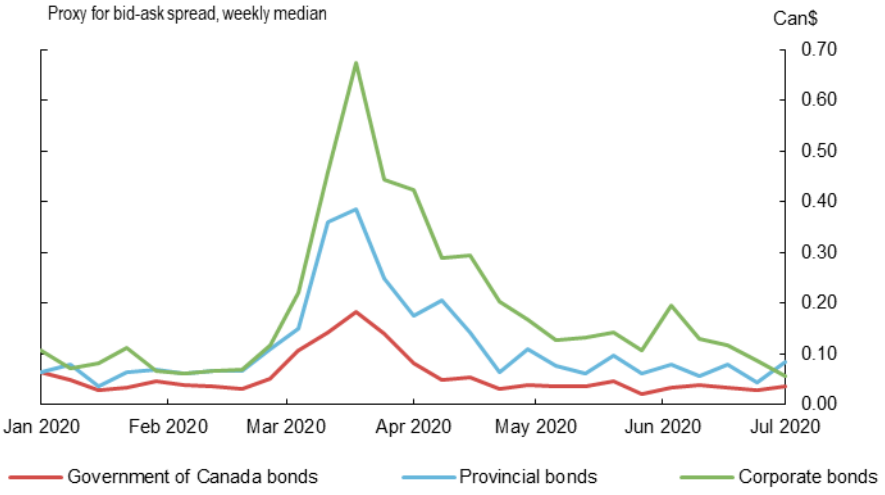
Sources: Statistics Canada and Bank of Canada calculations

Last observation: April 2020

Little was known about how long the pandemic would last or when (or whether) a vaccine would be available. Lockdowns in March 2020 closed large parts of the economy virtually overnight. The suddenness of these effects created shockwaves in the real economy and financial markets, leading to a generalized flight to safety, a sharp repricing of risky assets and a breakdown in the functioning of many markets. As

businesses and investors sought more cash to weather an extended period of uncertainty, demand for cash loans surged, and investors sought to sell securities to raise cash, but there were few buyers willing to purchase them. The scale and one-way nature of these flows caused extreme stress in financial markets. Corporate and provincial bond markets and money markets became severely dysfunctional. Even trading costs for Government of Canada (GoC) bonds, the safest assets in Canada, rose sharply (**Chart 2**).[5] This was particularly unusual, as government bonds are generally considered "flight-to-safety" assets that investors want to hold more of during times of extreme uncertainty. However, with the exceptional severity of the situation in early March, this was not the case.

Chart 2: Trading costs for bonds rose sharply



Sources: Canadian Depository for Securities Limited and Bank of Canada calculations

Last observation: June 30, 2020

Overnight, liquidity across all fixed-income markets dried up almost completely.[6] This acute market dysfunction jeopardized access to credit in the economy, affecting real economic activity and financial stability.

The fall in commodity prices—particularly the steep decline in the global price of oil (which even traded temporarily in negative territory)—also weighed significantly on the Canadian economy. As a result of widespread business closures and stress in financial markets, Canada's real gross domestic product (GDP) fell by 7.5% in March and an additional 11.6% in April.

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5 Trading costs are measured by a proxy for the difference between bid and ask prices. See Gungor and Yang (2017) for further definitions.

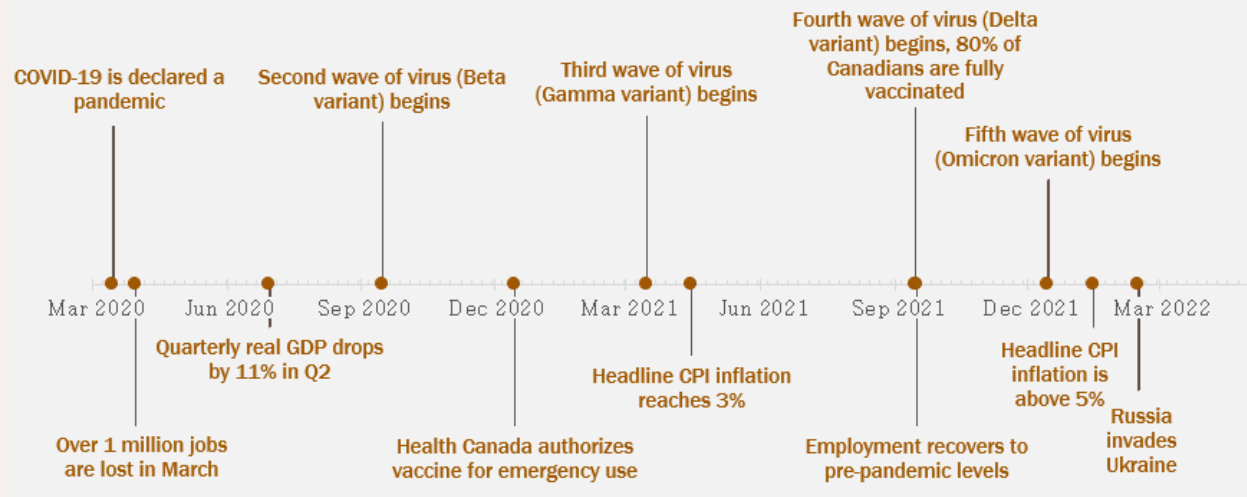
6 See Fontaine, Ford and Walton (2020), Gravelle (2021, 2023) and Fernandes and Mueller (2023).

Over the following 18 months, both positive and negative public health developments contributed to economic uncertainty (see **Figure 1**). While an earlier-than-expected arrival of vaccines was a welcome development, some initial setbacks in the delivery of vaccines to Canada made it difficult to gauge when vaccination of Canadians would be widespread. As well, there were questions about how well the vaccines would protect against new variants of the virus, especially Omicron.

Physical distancing measures were introduced, relaxed and reintroduced as these new variants of the virus circulated and subsided. The measures impacted people's personal and work lives. School and daycare closures affected children and impacted employment for parents, particularly those who did not have the ability to work remotely. Physical distancing measures not only changed over time but also varied within and outside Canada. A lockdown in one part of the world had significant repercussions for the availability of goods in other regions.

Understanding how these changing measures affected supply and demand was difficult. The Bank estimated that demand had fallen substantially more than supply. Although the estimate was subject to considerable uncertainly, it implied a large decline in underlying inflation and the need for significant monetary policy support.

Figure 1: Timeline of the health and economic situation in Canada



The Bank of Canada's policy responses

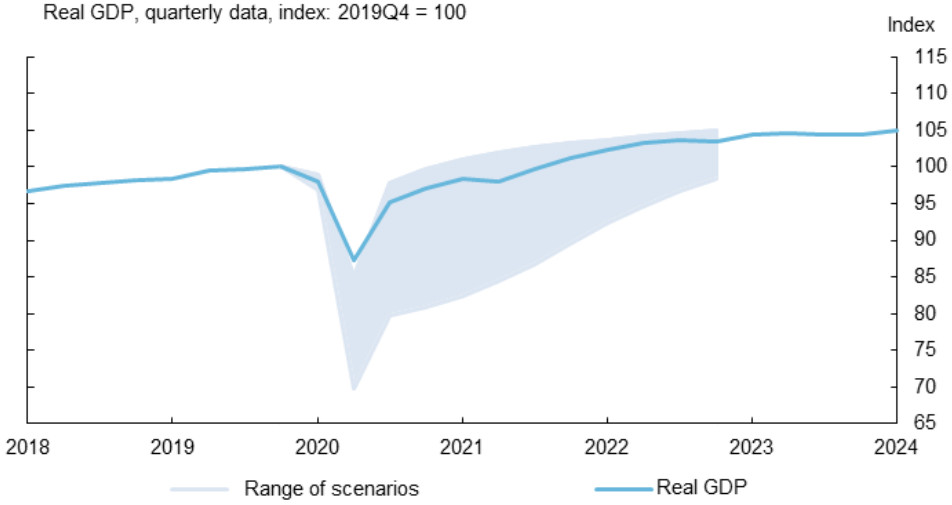
In March 2020, the Bank of Canada, like many central banks around the world, moved swiftly to cut interest rates—from 1.75% to 0.25% in less than a month—and stated that the policy interest rate had reached its effective lower bound (ELB). It also started to inject significant amounts of liquidity into the financial system through repurchase

agreements. Meanwhile, the Government of Canada, like other governments around the world, introduced several support programs to stabilize the economy. Like programs elsewhere, these were large (as a percentage of GDP) and helped to protect citizens from loss of income, restore confidence in the economy and avoid a downward economic spiral (see **Box 1**).

Given the unprecedented nature of this type of shock in modern economic history, policy-makers had no reference point to guide their judgments and economic projections. It was difficult to predict where the economy was heading. The decline in economic activity happened much faster than the drop during the Great Depression. In its April 2020 *Monetary Policy Report*, for the first time, the Bank did not publish a forecast for GDP. Instead, it provided illustrative scenarios of two possible outcomes: in the worst-case scenario, GDP would fall by 30% before recovering, while in the best case it would drop by 15% (**Chart 3**). Private sector market participants were predicting declines in GDP in a similar range.

Chart 3: In April 2020, the Bank of Canada used illustrative scenarios that estimated GDP would fall by 15% to 30%

Real GDP, quarterly data, index: 2019Q4 = 100



Note: In the April 2020 *Monetary Policy Report*, the Bank of Canada did not publish a base-case forecast for GDP.

Sources: Statistics Canada and Bank of Canada calculations and projections

Last observation: 2024Q1

During this time, the Bank took extraordinary actions, including extraordinary forward guidance and large-scale asset purchase programs. A significant portion of the asset purchases involved GoC securities through the Government Bond Purchase Program (GBPP). GoC securities play an important role in the Canadian financial system and for monetary policy. They serve as the benchmark, or reference rate, for almost every other credit market in Canada. If the GoC bond market cannot function smoothly, the proper functioning of the entire financial system—and the broader economy—becomes very

difficult. Additionally, a well-functioning GoC market is necessary for effective implementation of monetary policy.

The GBPP was implemented in two distinct phases. Each phase had a specific objective, which shaped how the program was communicated and executed. The objective of the first phase was to restore market functioning in the GoC securities market. This phase lasted from April to June 2020.

The program transitioned to a second phase in June 2020, aimed at providing the monetary stimulus required to achieve the Bank's inflation target. This is commonly referred to as quantitative easing, or QE, within the central bank community. This QE phase lasted until October 2021, when the Bank determined that the economic recovery was well underway, making it appropriate to end QE.

Box 1

The Government of Canada's COVID-19 economic response

During the 2020–21 fiscal year, the Government of Canada spent or lent approximately $300 billion for measures to protect the health and safety of Canadians, to directly support individuals and businesses, and to provide other liquidity supports for businesses. Canada ranked fourth among G20 countries for pandemic-relief spending as a percentage of GDP. The direct support measures for individuals included the Canada Emergency Response Benefit, which provided a $500 weekly benefit to workers who were unable to work because of the pandemic. The direct support measures for businesses included the Canada Emergency Wage Subsidy, which initially paid employers up to $847 weekly per employee to subsidize wages. The government's support was complemented by measures introduced by the Bank of Canada, the Office of the Superintendent of Financial Institutions and the Canada Mortgage and Housing Corporation. See the Office of the Auditor General of Canada's website for a detailed list of the Government of Canada's COVID-19 measures.

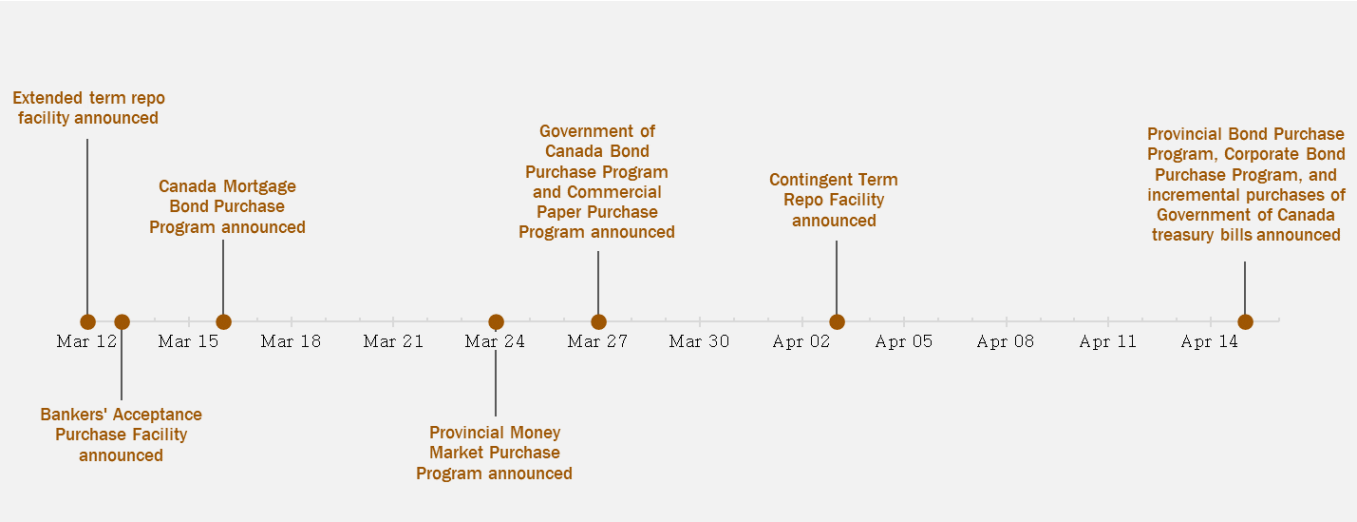
Asset purchases for market functioning

Between March and mid-April 2020, the Bank launched 10 exceptional programs to restore market functioning (see **Figure 2**).[7] Nine of these programs were implemented for the first time. Through these programs, the Bank purchased Canada Mortgage Bonds, commercial paper, bankers' acceptances, corporate bonds, and federal and

7 See Johnson (2023) and Fernandes and Mueller (2023) for a review of the Bank's market operations related to COVID-19.

provincial government debt. These purchases helped restore activity in markets and ensured that Canadian businesses, households and governments could continue to access essential credit.[8] By June, most markets had returned to more normal activity and the Bank announced that it was scaling back some market operations because financial conditions had improved.

Figure 2: Timeline of the Bank of Canada's announcements in 2020 of asset purchase programs and facilities



One of the most important programs was the Government of Canada Bond Purchase Program. In the first phase, the goal of the GBPP was to "address strains in the Government of Canada debt market and to enhance the effectiveness of all other actions taken so far" (Bank of Canada 2020d). The Bank committed to purchasing at least $5 billion in government bonds per week on the secondary market and to continuing its purchases until "…the economic recovery was well underway" (Bank of Canada 2020d).

Asset purchases for monetary stimulus (quantitative easing)

Considering the improved market conditions but still very weak economy in June 2020, the Bank transitioned to the second phase of the GBPP, stating, "Any further policy actions would be calibrated to provide the necessary degree of monetary policy accommodation required to achieve the inflation target" (Bank of Canada 2020a). Thus, the Bank's government bond purchases became QE. Under QE, the aim of the Bank's

8 For further details, see the Appendix.

bond purchases was to reduce market interest rates and thereby stimulate demand and return inflation to the Bank's 2% inflation target. Later in June, Governor Macklem reinforced the new objective of the purchases when he said the government bond purchases were "…working through more channels to deliver stimulus" (Macklem 2020).

The Bank adjusted its QE program over time to reflect economic developments:

- In October 2020, the Bank reduced the pace of its GBPP purchases to $4 billion per week. At the same time, it shifted its purchases to focus more on medium- and long-term bonds.
- In April 2021, the Bank reduced the pace of its GBPP purchases to a target of $3 billion per week. It tied this reduction to the progress made in Canada's economic recovery.
- In July 2021, it reduced the target pace further to $2 billion per week.
- In October 2021, given the progress in the economic recovery, the Bank ended its GBPP program and moved into a reinvestment phase.[9] The Bank of Canada was the first G7 central bank to end its pandemic QE program.
- In April 2022, the Bank announced that it was ending the reinvestment phase, one month after its first policy interest rate hike. This began the process of quantitative tightening (QT), where its government bond holdings would start to decrease.

Extraordinary forward guidance

The Bank also introduced forward guidance on how long the policy interest rate would remain at the ELB to anchor long-term rates. It did this by specifying the conditions that would have to be met before the Bank would raise rates from the ELB. Specifically, in July 2020 the Bank's Governing Council said it would "…hold the policy interest rate at the effective lower bound until economic slack is absorbed so that the 2 percent inflation target is sustainably achieved" (Bank of Canada 2020b).

The Bank adjusted its forecast each quarter, updating when it expected slack to be absorbed. In its July 2020 *Monetary Policy Report*, this condition was projected to be satisfied in 2023. In April 2021, with the vaccine rollout already well underway and the economy progressing, Governing Council expected economic slack would be absorbed

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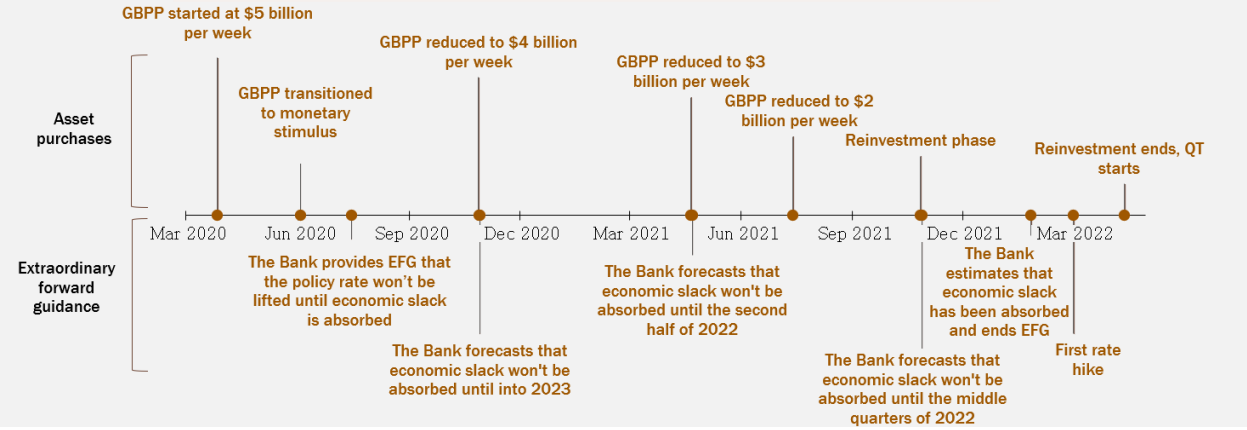
9 During the reinvestment phase, the Bank bought GoC bonds solely to replace bonds that matured. If it had not reinvested the proceeds of the maturing bonds, the Bank's government bond holdings would have declined. Later, the Bank's Governing Council said, "The Bank will keep its holdings of Government of Canada bonds on its balance sheet roughly constant at least until it begins to raise the policy interest rate. At that time, the Governing Council will consider exiting the reinvestment phase and reducing the size of its balance sheet by allowing roll-off of maturing Government of Canada bonds" (Bank of Canada 2022).

in the second half of 2022. Later, as the health and economic situations continued to improve, in October 2021, Governing Council updated its estimate of the end of the forward guidance period to the middle quarters of 2022.

In January 2022, with economic slack estimated to have been absorbed, Governing Council decided to end the extraordinary forward guidance (see **Figure 3**). At the next fixed announcement date in March 2022, the Bank raised the policy interest rate by 25 basis points (bps) to 0.5%. The Bank of Canada was one of the first advanced economy central banks to raise its policy interest rate from the ELB.

Figure 3: Timeline of Bank of Canada policy responses



Note: EFG is extraordinary forward guidance; GBPP is Government of Canada Bond Purchase Program; QT is quantitative tightening.

The inflation surge and policy responses

With the reopening of the economy, the rebound in economic activity in 2021 in Canada was faster and stronger than the Bank had anticipated. Several factors supported the rebound, including the relaxation of lockdown measures, the vaccine rollout and ongoing monetary and fiscal policy support. As a result, the inflation forecast was revised up every quarter to reflect the upside shocks (see **Box 2**).

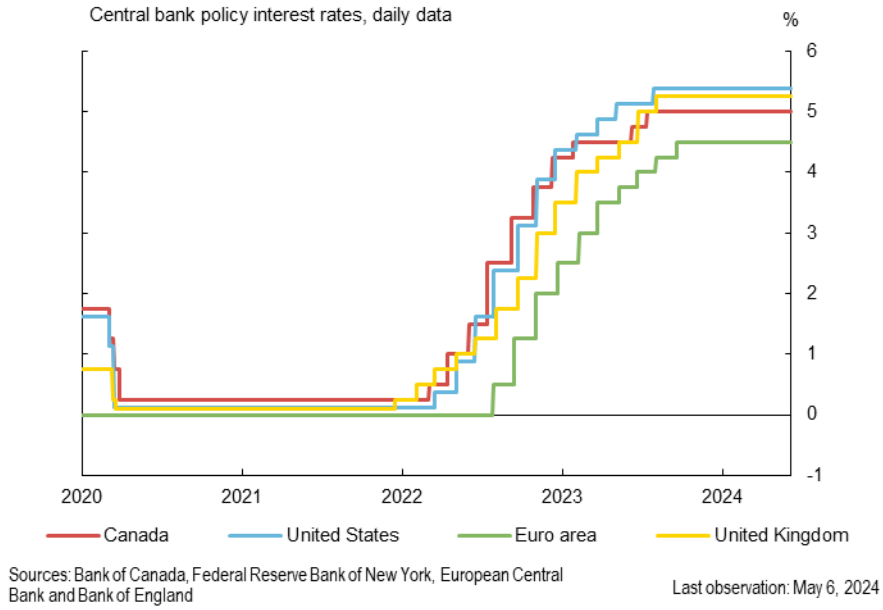
By January 2022, Governing Council judged that economic slack in Canada had been absorbed, and it ended extraordinary forward guidance. This assessment was complicated by the arrival of the Omicron variant—which led to new restrictions affecting demand—and supply chain disruptions lowering both supply and demand.

The outbreak of war in Ukraine in February brought another layer of complexity for policy-makers worldwide. It not only further exacerbated the pressure on energy and commodity prices and supply chain bottlenecks, but it also heightened uncertainty and

rattled financial markets just when policy-makers were contemplating the withdrawal of stimulus. The Bank nonetheless increased its policy interest rate in March 2022 and began QT in April. Inflation was 6.7% in March and went on to peak at 8.1% in June 2022.

The pace and magnitude of tightening by central banks in advanced economies to combat inflation were unparalleled in recent history (**Chart 4**). After its first 25 bps increase in March, the Bank began increasing its policy interest rate in larger increments. At its next six meetings, the Bank increased its policy interest rate by 50 bps, 50 bps, 100 bps, 75 bps, 50 bps and 50 bps, respectively, reaching 4.25% by the end of 2022. The policy interest rate peaked at 5.00% in 2023.

Chart 4: Most central banks tightened monetary policy in 2022–23



Box 2

The Bank of Canada's inflation forecasting performance after the COVID-19 crisis

The Bank of Canada significantly underestimated the strength and persistence of inflation in 2021 and early 2022 (**Chart 2-A**). Several factors contributed to this strength and persistence, including:[10]

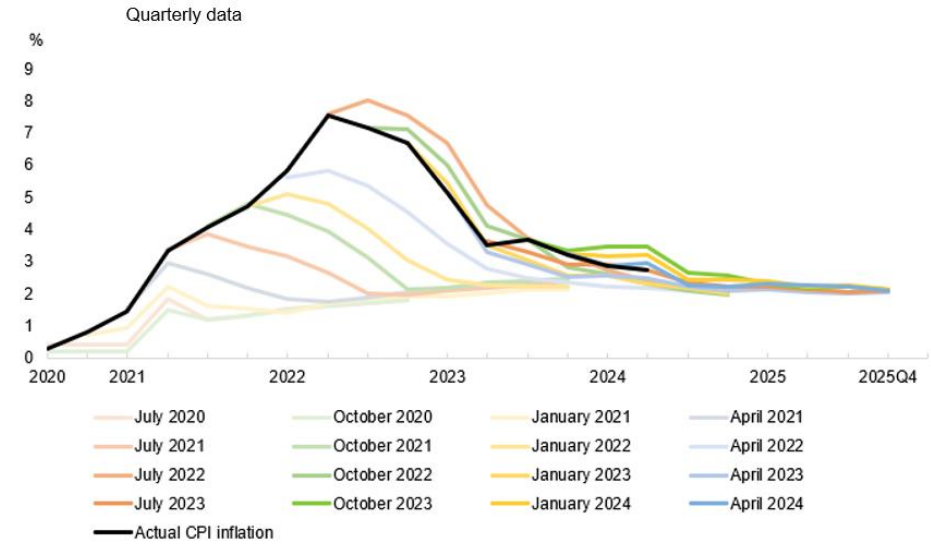
- unique impacts related to the COVID-19 pandemic
- Russia's unprovoked invasion of Ukraine

10 See Macklem (2024) for a discussion of the drivers of pandemic-era inflation and the Bank's response.

- significant changes in consumer spending patterns
- higher-than-usual pass-through of costs to prices

Each of these is discussed below, as are the efforts by Bank staff to update forecasting models in response.

Chart 2-A: The Bank of Canada significantly underestimated inflation pressures between July 2020 and July 2022



Note: CPI is consumer price index. Each series shows the inflation forecast at the time of each *Monetary Policy Report*.
Sources: Statistics Canada and Bank of Canada calculations and projections Last data plotted: 2025Q4

The pandemic affected supply and demand in complex ways

The unique circumstances that drove the unprecedented decline in activity during the pandemic, including public health restrictions, made it very difficult to determine the split between demand and supply factors impacting economic output. In the July 2020 *Monetary Policy Report*, the Bank estimated that supply factors accounted for about 60% of the 15% decline in GDP.[11] This implied that demand was roughly 6% below supply in the second quarter of 2020.

This balance between supply and demand was critical to the outlook for inflation. In general, weakness in demand could be expected to be a source of downward pressure on inflation, while weakness in supply would not. Businesses that were limited by public health restrictions from operating at full capacity, such as restaurants, had less incentive to reduce prices because it would not have materially increased their sales.

In retrospect, a greater share of the initial decline in GDP may have been supply-driven, and supply factors likely accounted for most of the increase in inflation (Chen and Tombe 2023). Global supply disruptions had a direct impact on import costs and transportation costs.

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11 This is relative to the fourth quarter of 2019. The Bank also acknowledged that these estimates were conditional on several assumptions and subject to considerable uncertainty.

Misjudging the split between demand and supply resulted in a larger inflation forecast error due to the sheer magnitude of the shock.

The rise in global inflation was exacerbated by other negative supply shocks during this period. Russia's unprovoked invasion of Ukraine pushed energy and agricultural goods prices sharply higher. Droughts and other weather-related events also contributed to higher commodity prices. In addition, the impact on price inflation in Canada from rising commodity prices was greater because the Canadian dollar did not appreciate to nearly the same extent that it had during past commodity booms. Overall, the unexpected rise in commodity prices accounted for about 45% of the Bank's one-year-ahead prediction error for CPI inflation in the second quarter of 2022.[12] In summary, this period was extremely unusual in terms of both the number and the size of shocks that all pushed inflation in the same direction.

Consumer spending on goods responded quickly

The Bank did not fully anticipate the speed of the rebound in demand relative to supply during the recovery phase. In particular, household spending shifted significantly toward goods and housing beginning in the second half of 2020. Supporting this robust demand were stimulative financial conditions and savings that households had accumulated because of increased government support and fewer spending opportunities. At the same time, continued supply chain and transportation bottlenecks as well as labour shortages in Canada and around the world slowed the rebound in supply. This caused a significant increase in the prices of many inputs used in production, as well as the prices of imported goods. Together, these factors account for about 40% of the Bank's one-year-ahead prediction error in the second quarter of 2022.

Evidence using consumer price index microdata shows that goods prices are usually adjusted more frequently than services prices. This contributed to stronger inflation pressures stemming from excess demand in the goods sector relative to disinflation pressures in the close-contact services sector. The Bank's main forecasting models missed this difference because they do not distinguish between prices for goods and prices for services.

Pass-through of costs to consumer prices increased

Another contributing factor was a notable rise in the share of cost increases that firms passed on to consumer prices. Historically, short-run pass-through of cost increases due to inflation in Canada has been small. However, given the size of the cost increases, firms began to raise their prices much more frequently than usual to help maintain their margins, which increased pass-through and further added to inflation (Bilyk, Khan and Kostyshyna 2024).

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[12] A detailed decomposition of the Bank's one-year-ahead prediction error for CPI inflation is provided in the Appendix to the Bank's July 2022 Monetary Policy Report.

Survey evidence for Canada also suggests that the pass-through of costs increased because of excess demand in certain segments of the economy—notably the goods consumption sector (Asghar, Fudurich and Voll 2023). With strong demand and limited supply, firms may have been less concerned about losing customers, leading to greater pass-through of costs.[13]

Lessons learned and future research

This episode highlights some shortcomings with models that feature the gap between GDP and potential GDP as the primary driver of underlying inflation. Increases in costs such as labour, commodities and imported inputs can reflect shifts in short-run supply and simultaneously cause output to fall and inflation to rise. Increases in the cost of critical inputs used in supply chains that have no close substitutes can have outsized effects on consumer prices.[14] Quantifying the impacts of these types of shocks on potential GDP can be difficult in real time. Therefore, it may be preferable to more closely monitor the prices of inputs to production.

Bank models such as the Terms-of-Trade Economic Model (ToTEM) include cost-based channels for inflation, but these models were underused during the pandemic. A wider set of scenarios should have been considered, including those featuring a more prominent role for businesses' costs in the consumption sector and higher-than-usual pass-through of costs. Bank staff are presently considering ways to include a wider range of plausible economic scenarios into the quarterly projection exercise.

The pandemic also highlighted that changes in the composition of demand can materially affect inflation. Measures of economy-wide activity may be misleading for consumer price inflation when:

- there is an important difference between the strength of consumption and the rest of the economy
- there are shifts in the composition of household spending, including housing demand

Finally, some aspects of price-setting behaviour depend on the state of the economy in ways that were not reflected in the Bank's economic models. Bank staff are currently exploring ways to incorporate state-dependent pricing mechanisms into the next generation of projection models, including the idea that the proportion of cost increases passed on to consumer prices may be greater when shocks are very large or when parts of the economy are in excess demand (Coletti 2023; Murchison, forthcoming).

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13 Asghar, Fudurich and Voll (2023) document that firms reported that customers acknowledged the global nature of supply chain disruptions, which likely softened the fear of antagonizing buyers with price increases.

14 Current Bank research is exploring the role that low substitution elasticities within production networks can play in better explaining inflation (Coletti 2023).

3. Evaluating the Bank's bond purchases to support market functioning

What are bond purchases to support market functioning and how are they meant to work?

A well-functioning financial system is essential for households and businesses to access the credit they need. It allows households to secure loans for significant purchases such as homes or motor vehicles, or to pay for things like education or unexpected expenses. Similarly, businesses depend on credit to invest in new projects, buy inventories, expand operations and create jobs. For a financial system to function well, the markets must be sufficiently liquid, allowing investors to trade quickly and at stable prices.

In times of stress, financial markets may become severely dysfunctional or even completely shut down. When uncertainty rises sharply, many investors want to sell assets to have more cash on hand or shift from riskier assets to safer options (flight to safety). Dealers, who purchase these assets from investors, become strained because they have to hold large amounts of these assets until they can find new buyers. At the same time, few investors may be interested in buying, which forces dealers to hold onto these assets for a long time, limiting their capacity to make further purchases.

At times like these, when sudden changes in economic conditions severely disrupt market functioning, dealers struggle to provide market liquidity. To support the liquidity of important assets like government bonds, central banks can step in and buy these assets. Central banks have the capacity to quickly expand their balance sheets and purchase securities, which can help meet sharp increases in the demand for cash, encourage trading activity through portfolio rebalancing, and mitigate contagion effects from disorderly asset sales.[15] This, in turn, improves financial stability by easing market dysfunction and helps restore the ability of the financial system to provide credit to businesses and households.

How and when were bond purchases deployed in Canada?

During the peak of the crisis, the Bank's top priority was to quickly restore well-functioning markets so that households, businesses and governments could continue to access credit—whether directly from markets or through banks and credit unions. The

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15 See Aldridge, Cimon and Vala (2023) for further discussion.

Bank designed and launched the extraordinary asset purchase programs and facilities to reinforce market functioning while prudently managing risk.[16] The programs mitigated risk by including term-to-maturity limits, minimum credit ratings, counterparty limits and concentration limits. When external asset managers were used, they were subject to strict conflict-of-interest requirements, well-defined mandates with limited discretion, and strong Bank oversight.

To maintain transparency, the Bank reported regularly on the results of its large-scale asset purchase programs, including the total holdings of assets purchased through these programs on its weekly and monthly balance sheets. It published dedicated webpages for each program showing the terms and conditions, as well as results of purchase operations.

These programs resulted in an unprecedented increase in the Bank's holdings of assets (**Chart 5**). Most of this increase can be attributed to three programs:

- the extended term repo facility (ETRF), which provided liquidity through repurchase agreements with Canadian primary dealers for terms of up to one year
- incremental Government of Canada treasury bill purchases to deal with the large increase in treasury bill issuance and associated market stresses
- the Government of Canada Bond Purchase Program

The Bank launched 10 liquidity programs to restore market functioning. This review focuses on the GBPP. Fernandes and Mueller (2023), Johnson (2023) and Gravelle (2023) provide an in-depth discussion and assessment of the Bank's other programs for market functioning. Among the market functioning programs, the GBPP stood out due to its significant size and the crucial role the Canadian government securities market plays in the financial system and the broader economy. The Bank committed to purchasing at least $5 billion in government bonds per week through the GBPP and to continue its purchases until "…the economic recovery was well underway" (Bank of Canada 2020d). The Bank conducted its GBPP operations four times a week and bought government bonds of all maturities, with each operation targeted at bonds in a specific maturity segment.

Between late March and early June, the period when the Bank purchased government bonds to support market functioning, the Bank's GoC bond holdings increased from

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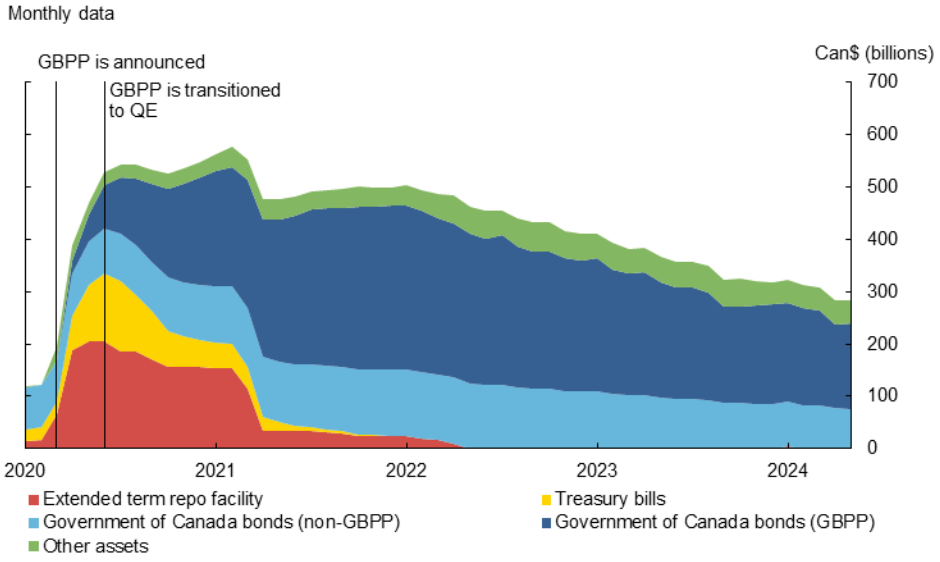
16 See the Appendix for dates and sizes of each program.

about $76 billion to about $135 billion (**Chart 5**). Most ($52 billion) of this increase was due to the GBPP program. The Bank's holdings of treasury bills also grew, from about $26 billion to about $108 billion over the same period. Its holdings of treasury bills peaked a month later before declining to almost zero by the fall of 2021.

Chart 5: The Bank of Canada expanded its balance sheet at the onset of the pandemic



Note: GBPP is Government of Canada Bond Purchase Program. QE is quantitative easing.
Source: Bank of Canada
Last observation: May 2024

In June and July 2020, as market conditions improved, the Bank announced that it was scaling back several market operations, including provincial money market purchases, incremental Government of Canada treasury bill purchases and term repo operations. Programs such as the Bankers' Acceptance Purchase Facility had already experienced decreased usage, and the Bank's holdings had declined due to the short-term nature of the assets purchased. The Bank also ended the first phase of the GBPP targeted at supporting the functioning of the GoC market.

What is the evidence that the bond purchases for market functioning worked?

The Bank's interventions helped restore market functioning quickly. In a short period of time, market liquidity and market functioning improved across a broad range of markets that are of system-wide importance. Trading costs reverted to normal levels, and selling and buying assets became easier.

Evaluating the financial market impact of individual asset purchase programs is not straightforward. Multiple facilities and programs were rolled out around the same time

and interacted with each other. In addition, other central banks around the world also rolled out similar programs that impacted global financial markets, including in Canada. This makes it difficult to isolate the impact of any single program. It is also not possible to know for sure how market liquidity would have evolved in the absence of these programs. Keeping in mind these challenges, Bank staff have attempted to evaluate the effectiveness of the GBPP and other asset purchase programs in improving market functioning.[17]

Between April 1 and June 3, 2020, the Bank purchased government bonds across all maturities worth Can$52.2 billion under the GBPP for market functioning.[18] By the second quarter of 2020, conditions in the GoC bond market had improved dramatically. Various measures of trading costs had returned to more normal (pre-pandemic) levels (**Chart 2**), and credit spreads across asset markets had narrowed significantly, mostly going back to their levels before the pandemic by the third quarter of 2020. These improvements were supported by the Bank's other extraordinary programs and likely by the programs launched by other central banks (most notably those of the Federal Reserve).

The extraordinary programs also helped ease funding pressures on Canadian banks. Banks came into this stressful period with strong capital and liquidity positions. But the cost of wholesale funding rose rapidly in March, due to both impaired market liquidity and increased concerns about the quality of banks' assets. These concerns reflected the potential for more loan losses as well as greater exposures from the use of credit lines and loan payment deferrals. The Bank's liquidity facilities and market-functioning asset purchase programs, along with government policies, resulted in better overall market liquidity conditions and helped ease the pressures in bank funding costs.

Despite the challenges in isolating the exact impact of the Bank's GBPP for market functioning from its later goal of monetary stimulus, the evidence suggests that the program's stated goals of restoring market functioning were achieved following its introduction.

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17 These findings were widely communicated through several speeches by members of Governing Council and through Bank publications and research. See Bank of Canada (2020c), Arora et al. (2020), Arora et al. (2021), Gravelle (2023), Johnson (2023), Fernandes and Mueller (2023), and Kozicki (2024).

18 During the pandemic, the Bank's regular primary market GoC bond purchases continued at the normal scale, resulting in an uptick in the total dollar amount of purchases because of the increased issuance of federal government debt at the time. Although these purchases were not part of the GBPP, they had similar effects in alleviating the pressure in the government debt market.

What were the risks and unintended impacts of the government bond purchases for market functioning?

Risk of decreased bond market liquidity

While large-scale asset purchases improve liquidity in the short term, longer-term effects may be quite different. When a central bank removes assets from the market, liquidity can worsen because fewer bonds are available to trade for private investors.

From late March to early June 2020, the Bank's GoC bond holdings increased, from about $76 billion to about $135 billion (**Chart 5**). At the same time, total bonds outstanding issued by the Government of Canada increased from $596 billion at the end of March to $662 billion at the end of June.

Even with the government's increased issuance, as the GBPP continued, some government bonds became scarce in the market. To address this scarcity, support core funding markets and foster the well-functioning of the GoC securities market, the Bank introduced securities repo operations (SROs) on July 27, 2020. The SROs temporarily provided GoC nominal bonds and treasury bills to primary dealers, supporting liquidity in the securities financing markets.

Risk of moral hazard

Moral hazard arises when market participants or other actors are more likely to take greater risks in normal times because they believe they do not have to bear the full consequences if things go wrong. After a central bank intervention, excess risk taking can increase if investors think that similar extraordinary policies will be available in the next market stress event. Additionally, dealers may be willing to hold less capital during normal times—not enough to weather an unexpected stress period—anticipating that the Bank will step in as the market maker of last resort to restore market functioning using its own capital.

The Bank takes moral hazard very seriously. If the Bank needs to intervene again in the future to restore market functioning, it will take steps to mitigate that risk. Some of the mitigation measures include offering extraordinary liquidity only during extreme market-wide stress, using penalty pricing to discourage reliance on the Bank's programs once market conditions improve, and setting clear expiry dates for programs to indicate their temporary nature.

What could the Bank do differently if it purchased bonds for market functioning again?

The sudden and severe market dysfunction during COVID-19 warranted an aggressive response. Several lessons for the future can be drawn from this experience that could inform changes to the design and implementation of a government bond purchase program if such a program is ever needed again. Lessons on the design and implementation of all the Bank's facilities to restore market functioning have been outlined in previous Bank work—in particular Johnson (2023) and Gravelle (2023). Most of those lessons are relevant for government bond purchases, and they are discussed below.

Clearly delineate government bond purchases for market functioning and for monetary policy. Government bond purchases can aim to restore market functioning, provide monetary stimulus, or serve both objectives. The GBPP was initially announced to improve market functioning, but it was tied to an economic outcome. This created confusion about whether the program was intended for market functioning, monetary policy or both. When the GBPP shifted from its market functioning phase to its monetary policy phase, the parameters and the condition related to the economic outcome remained unchanged. This may have added to the confusion. As well, GoC securities purchased during the market functioning phase remained on the Bank's balance sheet to provide monetary stimulus. This blurred the distinction between the GBPP for market functioning and QE for monetary stimulus.

In future programs, if the Bank's objective is strictly to restore market functioning, it should clearly communicate the specific market failures and stresses the program addresses, explain how it will achieve its objectives, and state from the beginning that the goal is to improve market conditions rather than to implement monetary policy. Any change in the program's objectives should also be communicated clearly to avoid policy uncertainty.

Be clear about the conditions for exit. A government bond purchase program for market functioning should be temporary, with clear communication that it will last only until the exit conditions are met. Ideally, these conditions should be tied to improvements in market conditions, such as measures of market liquidity, rather than to economic indicators. This would help distinguish asset purchases for market functioning from QE for monetary stimulus. It would also reduce the uncertainty for market participants, which would in turn reduce market volatility. For example, trading costs in

the GoC bond market returned to normal levels toward the end of April 2020, indicating that market liquidity was back to pre-pandemic levels (**Chart 2**). If the exit condition had been based on a market liquidity measure, such as trading costs, the program would have ended, or at a minimum wind down would have initiated at that time. Extending a government bond purchase program after market conditions normalize risks creating the perception that it is a form of QE, while ending it too early, before a sustained normalization, could bring back uncertainty.

After a stress event, once market conditions normalize, the Bank could sell the government bonds that were purchased for market functioning. If government bond purchases are necessary during a stress event only to support market functioning but the overall economy is expected to stay stable and the monetary policy interest rate is above the ELB, the bond purchases should be temporary, and the exit strategy could include actively selling the acquired assets. This would help delineate between restoring market functioning and conducting monetary policy, and it would help the Bank's balance sheet return to its normal size relatively quickly.

Under a different scenario, where a financial and economic shock leads to broader stresses in the financial system and economic activity, and where the policy interest rate is already at the ELB, the Bank may need to implement a government bond purchase program to serve both monetary policy and market functioning purposes. In this case, it is important that the Bank periodically review and adjust the program to ensure it is effectively targeted and appropriately scaled to address both market functioning and the needs of monetary policy.

Consider broader use of penalty pricing in programs for market functioning. Under penalty pricing, the Bank would purchase bonds at prices that would be attractive in stressed times but unattractive in normal times.[19] Purchasing bonds at prices and volumes that encourage private sector participants to return to the market can prevent prices from falling below a specified level. However, by offering to buy bonds at penalty prices, which are lower than those in less stressed conditions, the Bank can facilitate a natural exit from the program and a return to normal market activity by making the program less attractive as conditions improve. Determining the appropriate level of

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19 Several of the Bank's other asset purchase programs (Bankers' Acceptance Purchase Facility, Commercial Paper Purchase Program, Corporate Bond Purchase Program and Contingent Term Repo Facility) had penalty pricing, and their utilization naturally declined once conditions improved. In the Bankers' Acceptance Purchase Facility, the Bank set a minimum yield for its purchases. As conditions improved, usage dropped to nearly zero by August 2020. After this, the programs served as a backstop.

penalty pricing and effectively implementing it can be challenging, and in some cases, it may not be possible.

When penalty pricing is not possible, setting a predetermined review date could clarify that the actions are intended to be temporary. Upon review, the Bank may decide to renew or adjust the program or let it wind down. Setting a predetermined review date, however, has its own challenges, given the conditions of exceptional uncertainty in which these types of programs are needed. The Bank should be cautious not to extend the purchases after market conditions have stabilized, nor to end the program too early when market conditions are still fragile.

In sum, a government bond purchase program for market functioning should be designed so that it improves liquidity while also mitigating the potential risk of moral hazard. It should be clear about the conditions for exit and distinguish itself from QE. While the principles laid out here should guide the Bank's future actions, several issues deserve further consideration. For example, which specific market liquidity indicators or criteria should be used to inform the Bank's decision to start and end a market functioning program? How much flexibility does the Bank need to adapt these conditions to specific market situations?[20] How should the pricing be set on a government bond purchase program for market functioning? These questions are not straightforward and require deeper examination.

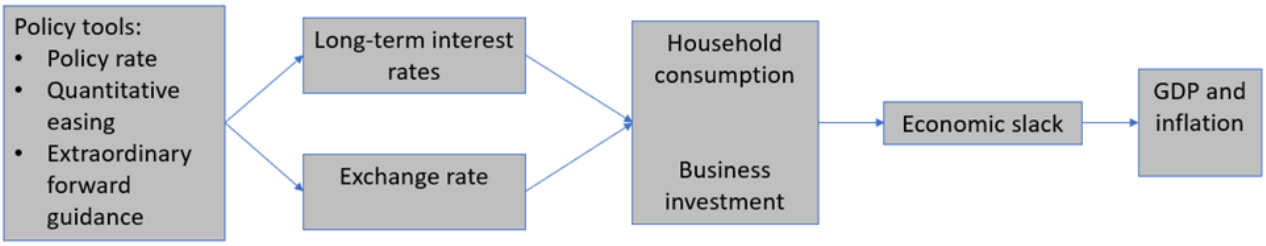
20 Duffie and Keane (2023) argue for pre-existing start and stop rules for purchases of government bonds for market functioning, suggesting these rules can offer clarity about the future availability of the program and reduce the government's funding costs.

4. Evaluating the effects of quantitative easing

What is quantitative easing and how is it meant to work?

Quantitative easing—the Bank's purchases of government bonds for monetary stimulus—is implemented in a similar way to its bond purchases for market functioning, but its objectives are different. Unconventional monetary policy tools such as QE work to achieve the Bank's inflation target in ways that are much like how changes in the policy interest rate work. These tools aim to reduce market interest rates and thereby stimulate demand and reduce excess supply in the economy (see **Figure 4**). QE attempts to reduce medium- and long-term interest rates when the policy interest rate is at its ELB. When interest rates decline, both the cost of borrowing to finance household spending and the cost of investing in new capital for companies decline. If domestic interest rates fall by more than foreign interest rates do, the exchange rate also tends to depreciate, helping to increase demand for domestic exports and lower demand for imports. Increased demand, in turn, helps to reduce economic slack and increase inflation toward the 2% target.

Figure 4: Stylized transmission of monetary policy



How QE reduces long-term interest rates

Under QE, a central bank buys government bonds. Buying government bonds raises their price and lowers their yield. Since government bonds are a benchmark for pricing other debt, this lowers the long-term interest rate on not only government bonds but also non-government bonds. To understand how QE influences the long-term interest rate on any bond, it is useful to break down the long-term interest rate into its components:

Long-term interest rate = Expectations for future short-term rates + Term premium + Other risk premiums

Long-term interest rates are driven by expectations for future short-term interest rates, a term premium, and other risk premiums such as a liquidity risk premium or a credit

risk premium. QE can potentially reduce the components of long-term rates through three channels.[21]

Signalling channel

In the signalling channel, QE works to reduce long-term rates by reducing expectations for future short-term rates. In effect, QE is a signal that the central bank thinks the overnight interest rate will remain at or near the ELB for a significant length of time. If the central bank intended to begin raising interest rates soon, there would be no need for QE.

Portfolio balance channel

Long-term bonds have a term premium because market participants need to be compensated for taking on the risk of holding long-term bonds. This risk is called interest rate risk. QE transfers some of this risk from the market to the central bank's balance sheet, thereby reducing long-term interest rates on a wide range of assets by reducing this term premium.[22] Entities that sell government bonds to the central bank may use the proceeds to purchase other assets, such as corporate bonds, which can raise the prices and lower the yields of these assets. In transferring risk to the central bank's balance sheet, QE reduces both government and non-government bond yields alike, which can help lower the costs of borrowing for banks, households and businesses.

Liquidity channel

QE can also reduce long-term interest rates by reducing the liquidity premium on government bonds, especially during episodes of market disfunction. The liquidity premium compensates investors for the risk that they would have to sell their security earlier than they would like to and at an unfavourable price. When market makers are unsure about whether they will be able to find a buyer for a security, they will be less willing to purchase that security in the first place. They would ask for a lower price (and higher yield) when they buy the security. When a central bank is in the market purchasing a security, market participants can be more confident they would be able to

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21 There is debate about how much of the reduction in long-term interest rates from QE can be attributed to each of these channels. The components of long-term rates are not observed and must be estimated. Bauer and Rudebusch (2014) estimate how much of the reduction in US interest rates was due to signalling versus other channels.

22 Here the focus is on QE purchases of government bonds. QE purchases of other assets (such as mortgage-backed securities purchased by the US Federal Reserve) may also reduce other risk premiums through a portfolio balance channel.

find a buyer for that security, and therefore they would accept a lower liquidity premium.[23]

How and when was quantitative easing used in Canada?

Before the pandemic, the Bank had never utilized a QE program. Although several other large economies introduced QE programs in response to the global financial crisis, there was no need for such a program in Canada. In June 2020, given the macroeconomic outlook—including severe downside risks to growth and inflation—the Bank began the second phase of the GBPP, which provided additional monetary stimulus via QE.

The Bank's government bond holdings continued to increase, peaking at almost $435 billion at the end of 2021, while holdings of treasury bills stayed near zero. The contrast in the movement of holdings of bonds and bills reflected the Bank's changing objective for its purchases. Before the transition, the Bank's holdings of both increased as it used purchases to address market functioning issues in both markets. After the transition, given its objective of providing monetary stimulus by reducing longer-term yields, the Bank moved away from purchases of securities with short-term maturity because they do not have much of an impact on longer-term yields.

Many other central banks also introduced significant QE programs in response to the economic fallout from the pandemic. Before the pandemic, the Bank's asset holdings, as a percentage of GDP, were much smaller than those of other developed economy central banks that had previously implemented QE programs. And during the pandemic, the Bank's QE program was smaller than that of many other developed economy central banks. From 2019 to 2022, the Bank's asset holdings grew by about 15% of GDP from 5% before the pandemic (**Chart 6**). The Federal Reserve's asset holdings grew by a slightly larger amount. Meanwhile, the asset holdings of the European Central Bank and the Bank of Japan grew by over 30% of GDP.

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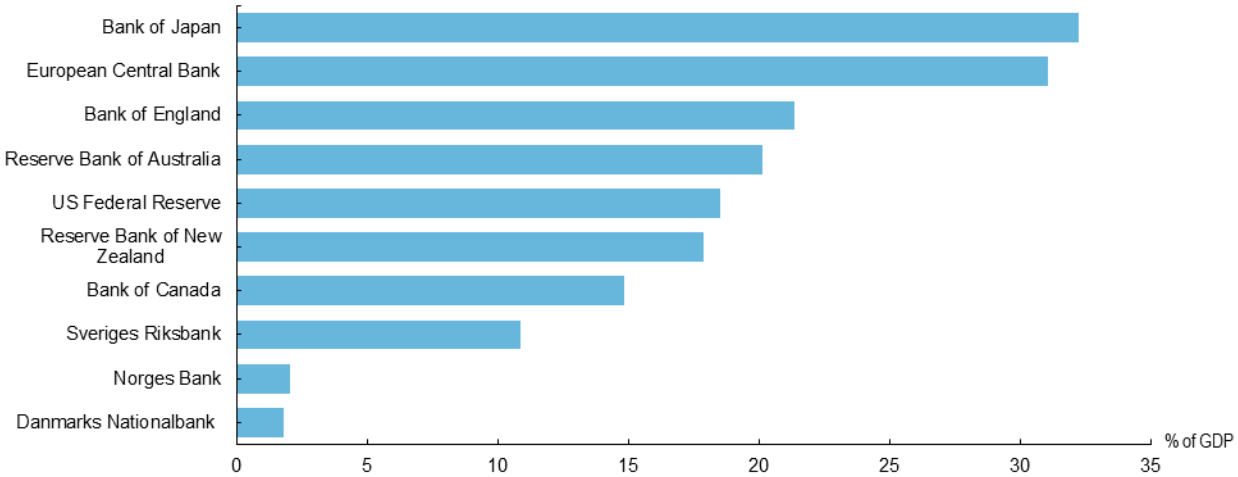
23 See Duffie and Keane (2023) for a discussion of central bank asset purchases for market functioning.

Chart 6: The Bank of Canada's balance sheet expansion was smaller than that of other central banks

Total change in central bank assets as a percentage of GDP from Dec 2019 to Dec 2021



Note: Central bank assets consist of public, private and other assets. Public assets include claims on central and local governments. Private assets include claims on banks, other financial institutions, public non-financial corporations and the private sector. Claims do not include guarantees—e.g., claims on public banks and corporations are deemed private assets even if they are guaranteed by the government. Other assets include foreign exchange and gold reserves as well as claims not captured as public or private assets.

Sources: Committee on the Global Financial System (CGFS) 2023 Working Group, London Stock Exchange Group's Datastream, International Monetary Fund, national data and CGFS Working Group calculations

How and when was quantitative tightening deployed in Canada?

QE is not meant to be a permanent expansion of a central bank's balance sheet: with QT, the balance sheet normalizes over time after QE ends.[24] QT can be thought of as the reverse of QE: the central bank unwinds its QE purchases, and the risks of those assets are removed from its balance sheet and put back in the hands of market participants when assets are sold or new debt is issued to replace maturing bonds.[25] And, just as QE shortens the maturity of government debt in the public's hands, QT essentially lengthens that maturity.

These processes are the reverse of each other, but that does not necessarily mean that their effects are symmetric. One reason is that in countries that have engaged in these policies, the pace of QT has been slower than the pace of QE. This suggests that QT may have a smaller immediate impact on financial markets than QE does. QE is more impactful when participants are less willing to absorb risk. The same is true of QT. However, while QE is most impactful if introduced when markets are under stress, QT is more benign if undertaken when markets are calm and better able to absorb issuance.

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24 Government debt monetization, in contrast, results in a permanent increase in the central bank balance sheet.

25 When the bonds mature and the central bank does not reinvest the proceeds, new bonds that are issued to replace the old ones are held by market participants.

Because these two tools are often deployed in these different situations, their impacts will likely differ.

Another reason for different impacts is the signalling channel. QE can help lower long-term rates because it is a signal that the policy interest rate will remain low. QT, in contrast, could have less of a signalling impact if there is no implied sequencing between the pace of QT and policy interest rate decisions.

In January 2022, a few months after it ended QE, the Bank stated that it would not begin QT before it started to raise the policy interest rate from its ELB. When the Bank raised the policy interest rate by 25 bps in March, it signalled that QT would be an active part of Governing Council's deliberations in April (Kozicki 2022). Indeed, the Bank began unwinding its balance sheet in April 2022, consistent with its earlier communications.

When launching QT, the Bank had to decide whether it would take an active or passive approach. Under a passive approach, the Bank would let its government bond holdings mature without reinvesting the proceeds. Under an active approach, the Bank would sell some of its GBPP holdings in addition to letting its government bond holdings mature.

The Bank decided to use a passive approach to QT for a number of reasons:

- The Bank wanted to use only one tool actively (policy interest rate changes) to adjust the amount of monetary stimulus in the economy. The Bank has a long experience using its policy interest rate to adjust monetary stimulus, while it had not done QT before. It also felt this would make monetary policy easier to communicate and understand since the policy interest rate is the Bank's primary monetary policy tool.
- The Bank did not need to sell bonds to achieve a relatively quick reduction in its balance sheet because many of its purchases were of shorter duration.
- A passive approach to QT meant that the decline in the Bank's bond holdings was entirely predictable. This predictability was important to ensure QT did not add to market uncertainty.

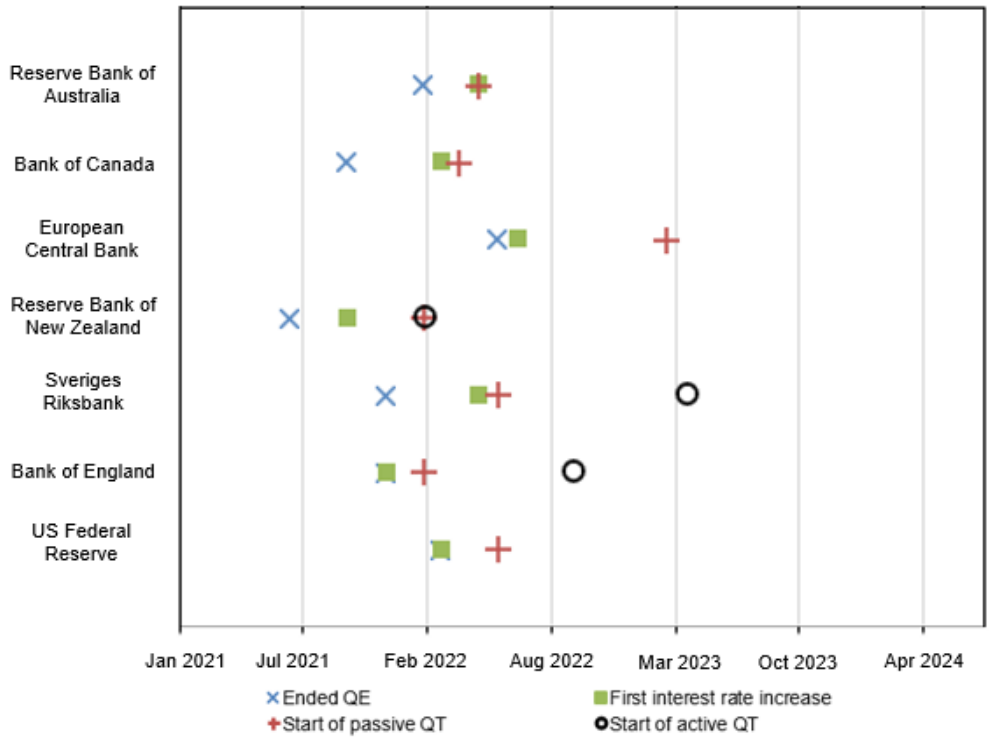
One outcome of a fully passive approach is that the pace of QT would be dictated by when the Bank's government bond holdings mature. This means that the interest rate risk of the Bank's GBPP purchases would remain on its balance sheet longer than with an active approach.

Since the Bank is taking a passive approach, the only other decision required is when to stop QT. The Bank stated that it aimed to reduce its balance sheet as much as it can

while still maintaining good control over the policy interest rate. The Bank estimated that it could still effectively target its policy interest rate when its settlement balances are between $20 billion and $60 billion (Gravelle 2023).[26] The Bank's settlement balances peaked at almost $400 billion in March 2021, were around $230 billion when it started QT in April 2022 and were about $110 billion in May 2024. Given the maturity profile of its government bond holdings, the Bank estimated that settlement balances would reach the $20 billion to $60 billion range by the end of 2024 or the first half of 2025. At that point, QT would be complete.

The Bank of Canada was among the first central banks to end QE (**Chart 7**). After a reinvestment period of about six months, the Bank started QT roughly in line with that of other major central banks. Even though it took a passive approach to QT, it had the second-largest decline in its QE holdings from the peak through to the end of 2023

Chart 7: The Bank of Canada was among the first central banks to end quantitative easing



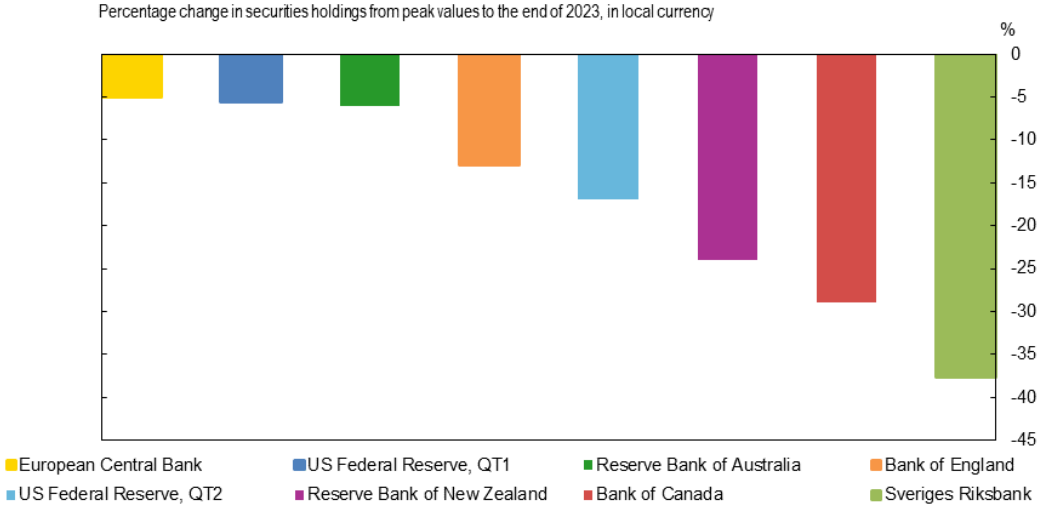
Note: Data are from W. Du, K. Forbes and M. N. Luzzetti, "Quantitative Tightening Around the Globe: What have We Learned?" National Bureau of Economic Research Working Paper No. 32321 (April 2024).

26 Settlement balances are a liability on the Bank's balance sheet. For an analysis and discussion of this range for settlement balances, see Bulusu et al. (2023). The Bank transitioned its framework for monetary policy implementation from a corridor system to a floor system, which requires larger settlement balances.

(**Chart 8**).[27] The Bank of Canada also plans to have a smaller balance sheet than other central banks when it ends QT. The Bank expects its settlement balances to be 1% to 2% of Canadian GDP when it ends QT. The US Federal Reserve, by comparison, is estimated to need reserves of about 10% to 13% of US GDP when it is done QT.[28]

Chart 8: The Bank of Canada had the second-largest decline in QE holdings through the end of 2023

Percentage change in securities holdings from peak values to the end of 2023, in local currency



Note: QE is quantitative easing. QT is quantitative tightening. The decline is calculated as the percentage change in QE holdings from their peak value (the largest value for the relative statistic) through Dec 2023 (through Nov 2023 for the Reserve Bank of New Zealand). This excludes *US Federal Reserve, QT1*, which is calculated as the percentage change in QE holdings from their peak before the pandemic (during the period of the mid-2010s through the end of 2019). Du, Forbes and Luzzetti (2024) refers to W. Du, K. Forbes and M. N. Luzzetti, "Quantitative Tightening Around the Globe: What have We Learned?" National Bureau of Economic Research Working Paper No. 32321 (April 2024).

Sources: Reserve Bank of Australia; European Central Bank; Reserve Bank of New Zealand; Sveriges Riksbank; Bank of England; Federal Reserve Economic Data; Du, Forbes and Luzzetti (2024); and Bank of Canada

What is the evidence that quantitative easing worked?

Quantifying the impact of QE is particularly challenging because the GBPP had two phases: it began as an asset purchase program to support market functioning, then shifted to a QE program to provide monetary stimulus.[29] Assessing each phase of the program separately using event studies is not possible because, when the GBPP was initially announced, markets began expecting asset purchases to continue well past June 2020, when the GBPP transitioned to QE. This means that a portion of the financial market impacts of QE happened during the first phase of the GBPP.

Because of the challenges in separately identifying the impact of each phase of bond purchases, the analysis in this report will assess the effects of QE by assuming that the impact of the GBPP is a good measure of the financial market and macroeconomic

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27 See Figure 2.3 in Du, Forbes and Luzzetti (2024).

28 See Lopez-Salido and Vissing-Jorgensen (2023).

29 Bank research assessing the impact of QE on yields has not distinguished between the two purposes of the GBPP. See Arora et al. (2021) and Azizova, Witmer and Zhang (2024).

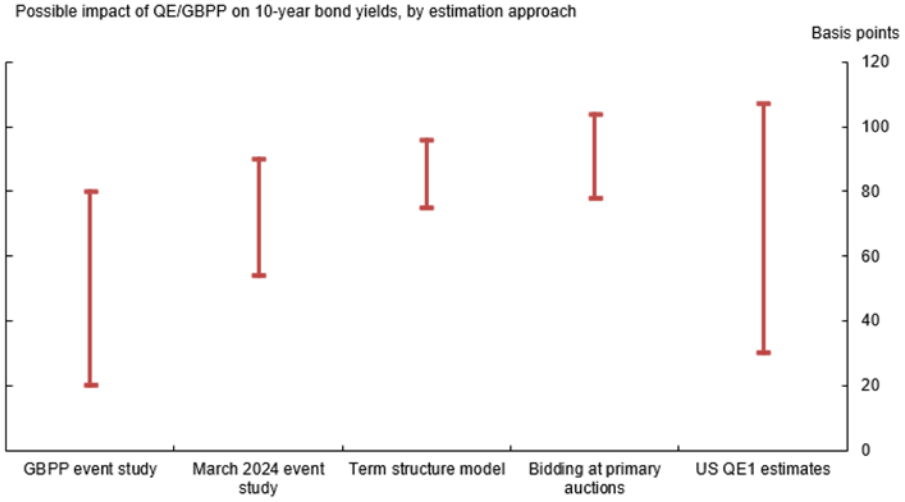
impacts of QE. While this approach may capture some impacts stemming from government bonds purchased in the market-functioning phase of the GBPP as QE, the vast majority of the impact of the GBPP is likely due to the expectations of purchases in the QE phase.

The financial market impact of the GBPP

This review considers two different approaches to estimating the impact of the GBPP and compares those estimates with studies of the impact of QE in other countries. Isolating the impact of the GBPP on bond yields is challenging because the Bank's implementation of the GBPP must be compared with what would have happened had the Bank not implemented the GBPP. These approaches attempt to determine what would have happened without the GBPP. Overall, the approaches suggest the GBPP may have kept 10-year bond yields between 70 bps and 90 bps lower than they otherwise would have been (**Chart 9**). These different approaches are described below.

Chart 9: Different estimates suggest the Government of Canada Bond Purchase Program may have restrained 10-year bond yields by 70 to 90 basis points

Possible impact of QE/GBPP on 10-year bond yields, by estimation approach



Note: GBPP is the Bank of Canada's Government of Canada Bond Purchase Program. QE is quantitative easing. Data for the GBPP event study and the March 2024 event study are from C. Azizova, J. Witmer and X. Zhang, "Assessing the Impact of the Bank of Canada's Government Bond Purchases," Bank of Canada Staff Discussion Paper No. 2024-5 (June 2024). Data for the term structure model are from A. Diez de los Rios, "Evaluating the Portfolio Balance Effects of the Government of Canada Bond Purchase Program on the Canadian Yield Curve," Bank of Canada Staff Analytical Note (forthcoming). Data for primary auction bidding are from B. Y. Chang, "Estimating the Slope of the Demand Function at Auctions for Government of Canada Bonds," Bank of Canada Staff Discussion Paper No. 2023-12 (June 2023). Data for US QE1 are from Committee on the Global Financial System, "Unconventional Monetary Policy Tools: A Cross-Country Analysis," Bank for International Settlements, CGFS Papers No. 63 (October 2019).

In the first approach, an event study estimates the impact of the GBPP by looking at changes in financial market prices within a small window around the time of a GBPP announcement. Using a short time frame means that likely nothing else is announced in the same window, so changes in prices in that time frame can safely be attributed to the GBPP. Such an event study makes two implicit assumptions:

- First, it assumes that the GBPP was unexpected. It takes as given that prices right before the announcement are what prices would be if there were no GBPP. If any

part of the GBPP is already expected (because, for instance, other countries are doing QE or the economy is very weak), an event study will underestimate the initial impact of the GBPP.

- Second, an event study assumes that the market reacts immediately and fully to the announcement. However, market participants could take time to digest the information in a GBPP announcement or they could overreact. Since an event study will miss price changes made after the announcement, it could overestimate or underestimate the impact of the GBPP.

Bank staff conducted an event study looking at the impact of the GBPP announcements between March 2020 and April 2022.

- Across several announcements, there was a 20 bps decline in 10-year yields and a 28 bps decline in 5-year yields.[30] There was also a 0.4% decline in the value of the Canadian dollar. Much of this impact happened around the first announcement of the GBPP on March 27, 2020, which reduced Canadian bond yields by about 10–15 bps, depending on maturity.[31] Around that initial announcement, market expectations for the future policy interest rate two years ahead barely moved, suggesting that the impact seen in yields was not due to a signalling channel.
- To get an estimate of the full impact of the GBPP, the Bank staff conducting the event study make some assumptions about how much the expectations for the amount of the Bank's purchases changed with the announcement. They then scale up the event study estimate to get an estimate of the full impact of the GBPP. This scaled-up estimate implies that the GBPP held 10-year bond yields 80 bps lower than they otherwise would have been.
- Deputy Governor Toni Gravelle's March 2024 speech about the size of the Bank's steady-state balance sheet after normalization had an impact on bond yields. Given market commentary, the same Bank staff estimate how much the expectations for the decline in bond supply changed, assuming the effect of normalization is the same as the effect of the GBPP. They then scale up the impact of his speech on bond yields to get an estimate for the overall impact of the GBPP of between 54 bps and 90 bps.

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30 See Azizova, Witmer and Zhang (2024) for an examination of these announcements and how they are scaled up to get an estimate of the total impact of the GBPP.

31 See Arora et al. (2021) for a full discussion of the impact of the initial announcement. It is important to analyze the impact of the GBPP in a small window of time. As Chart 1 in Arora et al. (2021) shows, a couple of hours after the GBPP announcement, Prime Minister Trudeau announced a fiscal package that increased bond yields. A larger window would have wrongly attributed the effect of this fiscal package to the GBPP.

The second approach to estimating the impact of the GBPP is to estimate the relationships between government debt supply or debt maturity and bond yields. This approach uses either models or historical relationships between debt maturity or debt supply and bond yields to estimate what bond yields would have been if the Bank had not done the GBPP.

- In a recent study, Bank staff develop a model of QE and calibrate it to the Canadian economy.[32] In that study, QE changes the average maturity of government debt held in the public's hands. In Canada, the GBPP decreased the average maturity of government debt by 1.4 years. In this model, the GBPP had an impact of between 75 bps and 96 bps on 10-year yields, depending on how long GBPP purchases remain on the Bank's balance sheet.
- In a different study, Bank staff estimate the slope of the demand curve of bidders at government debt auctions.[33] The study finds that in 5- and 10-year bond maturities, a bidder would demand 3–4 bps more for purchasing an additional $1 billion of government bonds. Assuming each bidder would have had to purchase $26 billion more government debt if there were no GBPP program, these estimates imply that bidders would have required between 78 bps and 104 bps to absorb that additional debt at an auction.[34]

To put these two approaches in perspective, this report looks at the financial market impact of QE in other countries. External research estimates this impact using similar approaches to those used here. Some QE programs in other countries were more of a surprise for market participants—especially programs that were implemented for the first time in response to the 2008–09 global financial crisis. Therefore, that external research may give a better estimate of the full impact of QE. However, QE was introduced mostly by large countries, and their experience may be less applicable to a small open economy such as Canada.[35]

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32 See Diez de los Rios (forthcoming). This model looks only at the portfolio balance channel of QE, so it may underestimate the impact of QE if other channels had an impact on yields.

33 See Chang (2023).

34 This assumes each of the 13 bidders takes an equal share of the $340 billion in GBPP purchases.

35 In a small open economy such as Canada, the effectiveness of this channel of QE depends in part on how similar—or substitutable—domestic bonds are to bonds in other countries (Diez de los Rios and Shamloo 2017; Kabaca 2016). If investors consider US and Canadian bonds to be very similar and can choose between the two, then the Bank's asset purchases, which represent a small share of the global market, would have little effect on Canadian yields.

- The QE that was initiated after the global financial crisis produced large impacts on 10-year bond yields, likely because it was less expected. However, estimates vary substantially, even for the same QE program. Different methodologies produce vastly different results. For example, the US program, QE1, is estimated to have reduced 10-year bond yields by 30–107 bps in the United States, depending on the study.[36]
- During the pandemic, advanced economies experienced an average decrease of 13 bps in bond yields around QE announcements.[37] Estimates vary, ranging from an increase of 14 bps in the 10-year bond yield in Sweden to a drop of 52 bps in the 10-year bond yield in New Zealand. Again, QE was likely already expected because some central banks had used QE during the global financial crisis. In terms of the exchange rate, there was an average drop of 0.22% in the value of the currency of the country announcing QE; in one case, the drop was as high as 3.6%.[38]

The financial market impact of quantitative tightening

As with QE, there are several challenges in estimating the financial market impact of QT. In most cases, central banks signal QT in advance so that it is expected by markets and will not cause a sudden financial market impact. Consequently, identifying the impact of QT on financial market prices is difficult. As well, in the Bank of Canada's case, QT announcements have coincided with policy interest rate announcements, making it difficult to determine how much of any increase in bond yields is due to QT and how much is due to a change in the policy interest rate. Nevertheless, external research has found that QT announcements have had a small cumulative impact (less than 10 bps) on long-term bond yields in Canada, compared with a cumulative increase of more than 30 bps in some other countries.[39] The same study found that announcements of active QT are associated with a larger increase in bond yields than announcements of passive QT.

The macroeconomic impact of the GBPP

The reduction in bond yields is just the first step in the transmission of QE to the macroeconomy (see **Figure 4**). Since monetary policy works with a lag, a model is needed to get a sense of how the reduction in bond yields impacts economic growth

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36 See Committee on the Global Financial System (2019). Estimate of 30 bps is from D'Amico and King (2013). Estimate of 107 bps is from Krishnamurthy and Vissing-Jorgensen (2011).

37 See Rebucci, Hartley and Jiménez (2020).

38 See Rebucci, Hartley and Jiménez (2020).

39 See Figure 3.4 in Du, Forbes and Luzzetti (2024).

and inflation. However, model results should be interpreted with caution. Models are typically based on data from non-crisis periods, and they may not give an accurate picture of the macroeconomic impact of policy actions made during crisis periods (Kozicki, Santor and Suchanek 2011). As well, while this review employs a standard way of assessing macroeconomic effects of policy by looking at the peak impact of that policy, the peak impact is an imperfect measure of the total impact of the GBPP because it does not account for the persistence of the effects of a given policy.

This review considers the impact of the GBPP on the macroeconomy using three different models. Each model relies on different assumptions so caution should be used when comparing their results. Nevertheless, they offer some insight into the impact of QE on the macroeconomy.

- In a recent study, Bank researchers use a model that explicitly takes into account the ELB on interest rates as well as a role for QE.[40] In this model, when the GBPP produces a 20 bps to 80 bps impact on 10-year yields, it has a peak impact of about 0.5%–3% on real GDP and 0.6–1.8 percentage points (pps) on inflation. However, this model is designed and calibrated to the US economy and so does not account for how effects may be different in a small open economy. More generally, different models and scenario assumptions can imply very different results and results may not be directly comparable. Keeping these caveats in mind, the estimates of the peak impact of the GBPP on GDP and inflation are larger using this model than in the Bank's projection models.
- The Bank's Large Empirical and Semi-Structural (LENS) projection model is estimated specifically for the Canadian economy and is one of the main models Bank staff use for Canadian projections.[41] While it does not explicitly model GBPP purchases, a modified version of LENS that incorporates a transmission channel between the GBPP and bond yields can provide an estimate of how the GBPP transmits to the economy. When it is calibrated so that the GBPP lowers bond yields (and borrowing

40 See Azizova, Witmer and Zang (2024).

41 See Gervais and Gosselin (2014).

rates for firms and households) by 20–80 bps, QE has a peak impact of about 0.2%–0.9% on real GDP and 0.1–0.3 pps on inflation.[42]

- Like LENS, the ToTEM model is estimated using Canadian data and serves as one of the Bank's main models for projections of the Canadian economy and related policy analysis.[43] When calibrated to produce a 20–80 bps decline in long-term rates, ToTEM finds the peak GDP impact to be somewhat larger than in LENS (0.4%–1.5%), whereas the peak inflation response is identical to that in LENS (0.1–0.3 pps).[44]

To put these estimates in perspective, it can be useful to also look at the estimated macroeconomic impacts of QE in other jurisdictions. Many studies evaluate the macroeconomic impacts of QE in larger countries during the global financial crisis. The benefit of looking at these other studies is that ample time has passed, so the lagged macroeconomic impact of QE can be seen. Also, these studies apply a variety of methodologies, and it is possible to get a sense of how these different methodologies may produce different results. The downside of relying on these other studies is twofold: first, QE was introduced in response to a different kind of crisis (i.e., a banking crisis instead of a pandemic). Second, transmission of QE to the macroeconomy may be different in a small open economy such as Canada.

Nevertheless, across different QE programs during the global financial crisis in different countries using different methodologies, most studies suggest that the peak impact of QE on GDP ranges from 0% to 3%, while the peak impact of QE on inflation generally ranges from 0 pps to 2 pps (**Chart 10**). Research also suggests that the macroeconomic effects of QE programs are larger when the programs start with stressed financial conditions.[45]

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42 In LENS, GBPP purchases lower long-term yields by reducing the term premium. The model simulations assume the full impact on the term premium is reached almost immediately after the announcement of the policy in the second quarter of 2020 and persists for about two years. The impact on the term premium is assumed to start dissipating in 2022 and declines to about one-quarter of its maximum size by the end of 2024. The impact on the level of GDP, in contrast, builds up gradually and reaches its peak at the end of 2021.

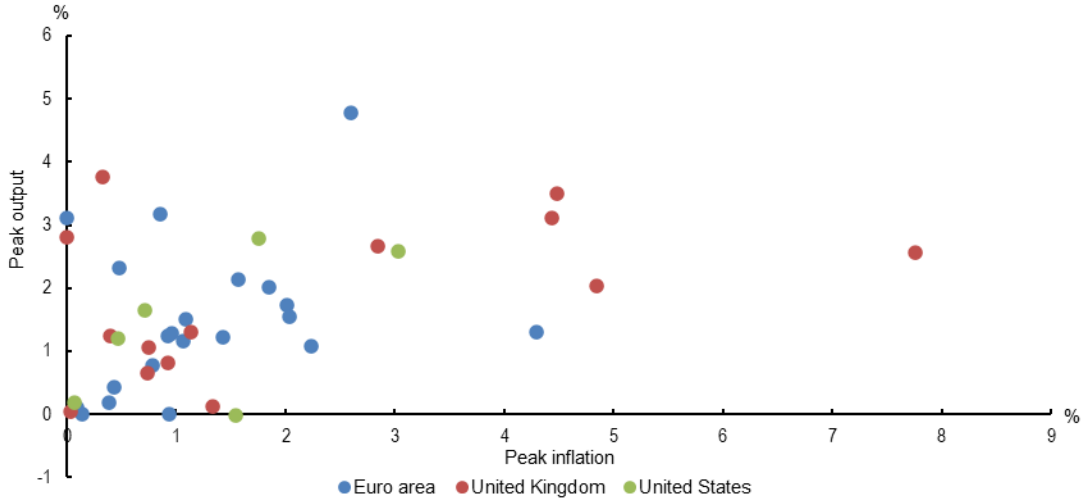
43 See Corrigan et al. (2021).

44 See Schlanger et al. (forthcoming).

45 See Haldane et al. (2016) and Hesse, Hofmann and Weber (2017).

Chart 10: Most studies suggest that quantitative easing had a peak impact on real GDP of less than 3%

Peak impact of programs implemented following the 2008–09 global financial crisis



Note: The chart shows results from studies looking at quantitative easing programs that purchased total assets worth at least 5% of GDP. Data are from B. Fabo, M. Jančoková, E. Kempf and Ľuboš Pástor, "Fifty shades of QE: Comparing findings of central bankers and academics," *Journal of Monetary Economics* 120: 1–20 (May 2021).

To summarize, quantitative estimates of the macroeconomic impact of QE are model-dependent and show large variations in magnitude. It is challenging to isolate the economic impacts from during the pandemic, but the findings suggest that QE played a supporting role in loosening overall monetary conditions. This increased Canadian economic activity and real GDP, which helped keep inflation from falling too far below the inflation target. This was key when policy interest rates were constrained at the ELB.

What were the risks and unintended impacts of quantitative easing?

Interest rate risk is transferred to the Bank's balance sheet

QE transfers risks from markets to the central bank's balance sheet at a time when the economy is facing a bleak outlook and pervasive uncertainty. The Bank funded its QE asset purchases with short-term liabilities (mainly settlement balances), for which the Bank pays the policy interest rate. As a result, the Bank became exposed to significant interest rate risk, which caused volatility in its income. When the bonds purchased through QE were paying a higher coupon interest rate than the policy interest rate paid on the liabilities that funded the purchases, the Bank's net income was significantly higher than normal. As a result, the Bank remitted more than $2 billion in additional net income to the government over 2020 and 2021. When the policy interest rate paid on the liabilities increased above the coupon rate of the bonds purchased, the Bank generated net losses. QE programs implemented in other countries during the

pandemic also generated losses, given the increase in interest rates in response to the post-pandemic surge in inflation.

From an accounting perspective, QE impacts on income have two sources:

- First, the assets purchased under a QE program can create a net interest revenue or expense. An expense occurs if the coupon rate of the bonds purchased is lower than the policy interest rate paid on the liabilities funding those purchases. A net interest expense reduces the Bank's net income and can also be considered as increasing cost from the government's perspective (see **Box 3**).
- Second, there can be a fair value loss (gain) when the market value of the bonds purchased under the QE program fluctuate as a result of interest rates increasing (decreasing).

These two sources of income and loss are discussed separately in the context of the costs of the Bank's GBPP program.[46]

Net interest revenue (or expense)

Net interest revenue (or expense) represents the difference between the Bank's interest revenue and interest expense. The Bank earns interest revenue on its investments in GoC securities, on securities purchased under resale agreements (if any) and on assets acquired through large-scale asset purchase programs. Interest expense consists mainly of interest paid on settlement balances and other deposits held by the Bank.

The Bank has only recently reported net losses, mainly due to a higher net interest expense driven by increased funding costs. Since 2022, the Bank's interest expense has increased (**Chart 11**) both because the Bank's settlement balances grew and because its policy interest rate rose from 0.25% to 5% due to the unexpected inflation surge.

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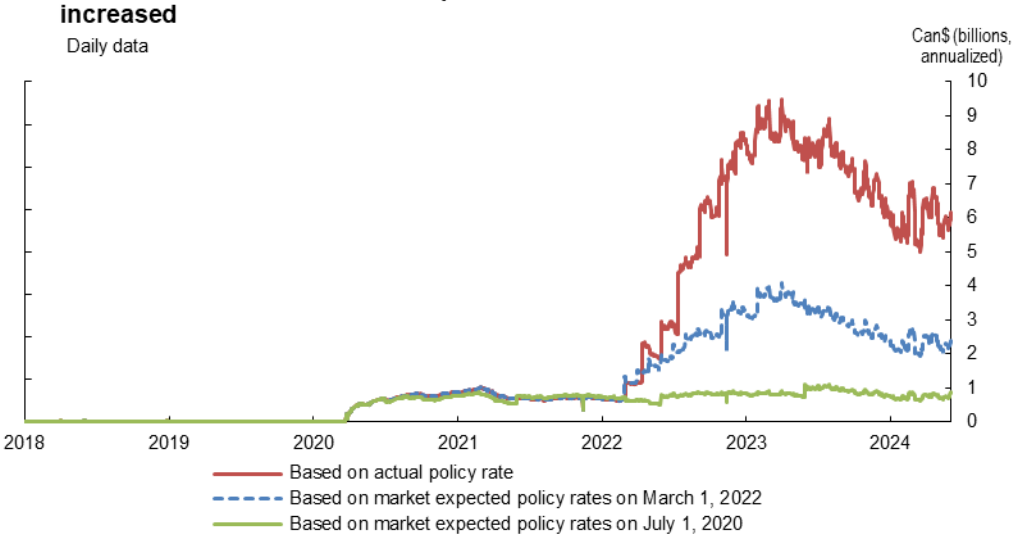
46 This review provides losses for the GBPP, which do not correspond exactly to QE losses. These losses do not include losses related to bonds the Bank purchased at primary auctions. Some portion of primary auction purchases may be considered QE because the Bank was purchasing a larger quantity through primary auctions due to the government's increased issuance.

Chart 11: The Bank of Canada's interest expenses have climbed as interest rates have increased



Note: This chart presents estimates of the Bank of Canada's daily (annualized) expenses for interest paid to depositors. Tombe (2023) refers to T. Tombe, "Finances of the Nation: From Bonds to Banknotes—Central Banking and Public Finances in Canada," *Canadian Tax Journal / Revue fiscale canadienne* 71, no. 3 (2023): 825–852.

Sources: Tombe (2023) and Bank of Canada calculations

Last observation: June 4, 2024

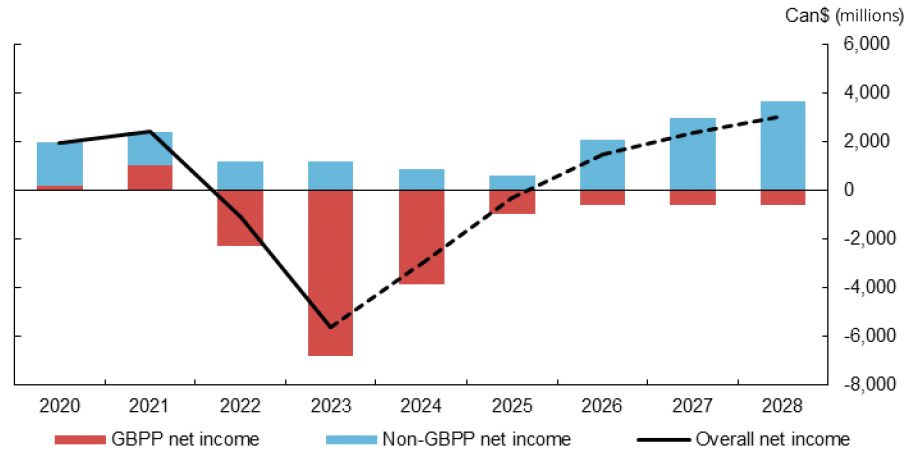
Without the post-pandemic inflation surge (see **Box 2**) and the higher rates that followed, the Bank's interest expense would have been much smaller.[47] If the interest rate path implied by financial markets in 2020 (**Chart 11**, green line) or 2022 (**Chart 11**, blue line) had materialized, the funding costs would have been much lower, and the interest expense would have been significantly smaller. For example, in September 2021, US primary dealers were forecasting a 0% probability that the US federal funds rate would be above 1.5% by the end of 2022 and a 2% probability that it would be above 2% by the end of 2023.

The higher interest rate expense being incurred by the Bank is temporary, and the Bank forecasts it will return to a positive net income position by 2026 (**Chart 12**).

47 QE does not always lead to interest income losses. In the aftermath of the global financial crisis, the Federal Reserve made large profits from interest on bonds it purchased for QE.

Chart 12: The Bank of Canada expects to return to profitability by 2026

Annual data



Note: GBPP is the Government of Canada Bond Purchase Program. For future profitability, the policy interest rate is assumed to follow the market-forecasted path.

Source: Bank of Canada

Last observation: July 31, 2024

Fair value fluctuations

The bonds the Bank purchased through the GBPP are recorded at fair value, which represents the price at which those bonds would trade in the current market. The change in fair value of the bonds in the GBPP portfolio carried by the Bank is recorded as a net unrealized gain or loss. These gains or losses are realized only if the Bank sells the bonds.

When the GBPP was introduced, the Government of Canada agreed to indemnify the Bank from market fluctuations; consequently, the fair value fluctuations of the bonds the Bank purchased in the GBPP do not impact the Bank's net income. Instead, any unrealized losses indemnified by the agreements are accounted for as an asset on the Bank's balance sheet.[48] Any realized losses resulting from the sale of GBPP assets would be indemnified, and any gains on disposal would be remitted to the government.[49]

Some studies, such as Fortin (2022), use the value of the indemnity on the Bank's balance sheet to estimate the costs of the GBPP. The indemnity fluctuates with interest rates and the size of the holdings. The indemnity value was approximately $6 billion at the end of 2021, peaked at around $33 billion at the end of the third quarter of 2023, and has since declined to about $21 billion at the end of July 2024. The value of the indemnity can be thought of as a measure of the present value of future net interest

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48 On the Bank's balance sheet, this indemnity is currently an asset since the fair value fluctuation resulted in an unrealized loss.

49 See Government of Canada Bond Purchase Program on the Bank's website for details on the indemnity.

income losses if each purchase was funded by settlement balances at the policy interest rate until it matures. The value of the indemnity represents the loss the Bank would sustain if it sold at current market prices all the GBPP securities it currently held. That is, if the Bank sold all the bonds in July 2024 at market prices, it would realize the fair value loss of $21 billion but would not have any future net interest income losses related to the GBPP. In implementing QT, the Bank has chosen to not sell the securities it purchased through the GBPP and to allow these bonds to mature.

Box 3

The impact of quantitative easing on the government's fiscal position

Quantitative easing (QE) has the potential to impact the government's fiscal position in at least three important ways:

- The financial market impact of QE on bond yields can reduce the cost of government bond issuance.
- The macroeconomic impact of QE can increase government tax revenues.
- The interest rate risk of the Bank of Canada is, in effect, transferred to the government.

Each of these is discussed below.

Quantitative easing can reduce government issuance costs

If QE reduces bond yields, it is less costly for the government to issue long-term bonds. Earlier estimates by Bank staff suggest that QE may have reduced long-term bond yields. From April 2020 through the end of 2022, the federal government issued over $750 billion worth of bonds, some of which replaced maturing bonds and some of which represented net new issuance. If the Bank had not implemented its QE program, the government would have paid a higher yield on all these bonds, especially those with longer maturities.

Quantitative easing can increase government tax revenues

Earlier in this report, estimates suggest that QE increased Canadian gross domestic product (GDP). A higher GDP implies higher tax revenues for the Government of Canada. A study by the International Monetary Fund shows that QE can substantially improve a government's fiscal position (relative to the case without QE), and most of this improvement in the study reflects increased tax revenues (Adrian et al. 2024).

The interest rate risk of the Bank is, in effect, transferred to the government

QE essentially shortens the maturity of government debt.[50, 51] Central banks remove long-term government bonds from the market and replace them with settlement balances, which effectively are a short-term liability of the government. Normally, yields on long-term debt are higher than yields on short-term debt. When this is the case, it is relatively inexpensive for the government to replace long-term debt with short-term debt. However, an increase in short-term debt exposes the government to the risk that interest rates will rise. When interest rates rise, it is more costly for the government to have short-term debt because funding costs on long-term debt are stable. Governments balance this trade-off and usually have a plan for how much debt at different maturities they will issue to the market.[52]

Since QE shortens debt maturity, QE could lead to the government having more short-term debt than it intended. It could also lead to a situation where the fiscal authority might be trying to lengthen debt maturity to take advantage of low and stable funding costs, whereas the central bank might be trying to shorten that maturity to remove interest rate risk from the market.

Risk to perceived central bank independence

The central bank's credibility and public trust are crucial to its ability to keep inflation near the target.[53] If people perceive that the central bank is not independent of the government, they may believe that the central bank is focusing on political goals rather than focusing on keeping inflation near its target.

QE has the potential to reduce the perceived independence of the central bank in three ways:

- QE and emergency fiscal programs are implemented at the same time—that is, in times of crisis. Several times during the pandemic, fiscal and central bank measures

50 Under the *Bank of Canada Act*, the Bank is required to distribute all its income to the government but cannot distribute its losses to the government. However, in June 2023, Parliament passed legislation allowing for the temporary non-application of sections 27 and 27.1 of the *Bank of Canada Act*, giving the Bank the ability to retain future income until the earlier occurrence of either (a) its retained earnings are equal to zero, or (b) the ascertained surplus applied to its retained earnings is equal to its losses arising from the purchase of Government of Canada securities purchased under the GBPP from April 1, 2020 to April 25, 2022. Ambler, Koeppl and Kronick (2022) provide arguments on why the Bank should be able to retain future income. See https://www.parl.ca/DocumentViewer/en/44-1/bill/C-47/royal-assent for details on the non-application of the *Bank of Canada Act*. On May 16, 2022, the Bank began remunerating government deposits related to the GBPP at 0% instead of at the policy interest rate.

51 See Chu et al. (2022), Tombe (2023) and Diez de los Rios (forthcoming).

52 As an example, see the Government of Canada's *2024-25 Debt Management Strategy*.

53 See Rogers (2022) on why this is important to achieve the Bank's objectives.

were announced at the same time, which could lead to the perception that the central bank is working under the direction of the fiscal authority. In reality, however, a large shock hit the economy and both fiscal and monetary authorities reacted, consistent with their respective mandates.

- When undertaking a QE program, the central bank may agree on an indemnity with the central government. This can create a perception that the central bank is dependent on the government.
- A central bank is different from a commercial bank in that it does not have the objective of generating income or profit. A central bank can operate with ongoing losses or with negative equity without putting at risk its continued operation or its ability to meet its mandate.[54] However, losses incurred by a central bank can cause the public to question what is motivating the central bank's decisions, and this can damage the effectiveness of its decisions.

Risk of bond market scarcity

QE can lead to a scarcity in government bonds. When it ended the GBPP program in October 2021, the Bank held over 40% of the outstanding GoC bonds, and it held more than half of certain individual bonds by the time it started QT. The Bank was aware of this scarcity issue and tried to mitigate it as much as possible with guidelines on the proportion of individual bonds the Bank would hold.

The Bank also introduced SROs in July 2020 to support core funding markets and the GoC securities market. In these operations, the Bank lent securities overnight back to the market. The Bank adjusted the program's terms as needed to ensure that markets continued to function well. Generally, the securities the Bank lent were ones it had bought as part of the GBPP. At the peak of its SROs, the Bank was lending out overnight more than $40 billion worth of its government bond holdings.

Risk to inflation

The intended macroeconomic effect of QE is to provide monetary stimulus and raise inflation back to central bank targets during a crisis, when the policy interest rate is at the ELB. By lowering interest rates, QE can help lower the cost of borrowing for both households and businesses. A reduced cost of borrowing increases demand, which helps to reduce economic slack and bring inflation up toward the 2% target. While, in

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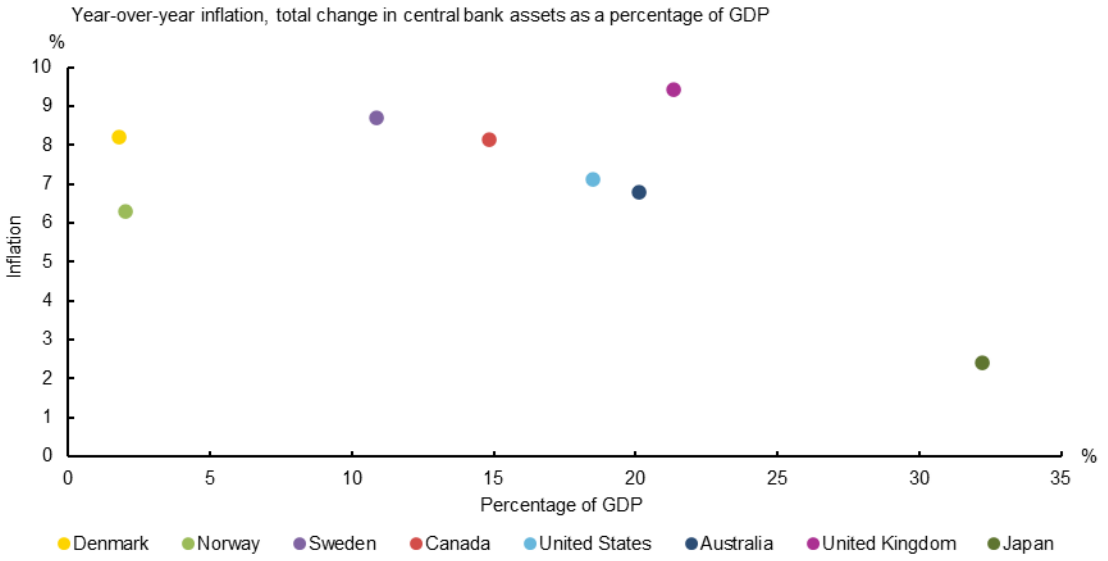
54 The central bank can remain solvent even with a negative equity position. Hall and Reis (2015) explain why this is the case and suggest that the amount of losses a central bank can sustain before becoming insolvent is quite large. Further, section 34 of the *Bank of Canada Act* provides that no statute relating to the insolvency or winding-up of any corporation applies to the Bank.

principle, QE programs could have contributed to the post-pandemic surge in inflation above target, the Bank's estimates suggest that monetary policy actions, including QE, did not, on their own, push inflation above 2%.

After the 2008–09 global financial crisis, inflation was subdued in countries that conducted large QE programs. In Canada, although money growth and inflation increased following the pandemic, they did not move together before the pandemic.[55] Additionally, inflation was high across all countries, even those that had minimal changes to their central bank balance sheet (**Chart 13**).

Chart 13: Countries with larger quantitative easing programs did not experience higher inflation than those with smaller programs



Sources: Statistics Denmark, Statistics Norway, Statistics Sweden, Statistics Canada, US Bureau of Labor Statistics, Australian Bureau of Statistics, Office of National Statistics (UK), Japan Ministry of Internal Affairs and Communications

Last observations: change in central bank assets, Dec 2019–Dec 2021; inflation, June 2022

What could the Bank do differently if it used quantitative easing again?

QE was a useful and necessary tool during the pandemic to support economic activity when the policy interest rate was constrained at the ELB. When the economy was in a free fall during the pandemic, the risks of the Bank not acting were substantial. The experience during this episode provides some lessons learned for future policy.

The Bank could use specific market conditions as an indication of when it may be most effective to launch QE.[56] QE purchases made during periods of economic stress

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55 Money growth is the growth of all currency in circulation as well as chequing and savings deposits. See Kozicki (2024) for more details.

56 See Krishnamurthy (2022) for a discussion of some possible conditions that can be used to guide QE purchases.

tend to have more impact on financial markets and the economy.[57] Bank research after the global financial crisis points out that at some point, the costs of QE purchases likely outweigh their benefits.[58] Where exactly to draw the line is a matter of judgment. Many of the Bank's market-functioning operations naturally declined because market rates were better than the terms the Bank was offering. It may be possible to design QE in such a way that the quantity of bonds the Bank purchases becomes smaller once the purchases are less effective as monetary stimulus. Instead of purchasing a specific amount each week, for example, the Bank could commit to a weekly target amount and purchase less if the yields are lower than a minimum threshold.[59]

The Bank could use a QE exit condition more closely related to its monetary policy mandate and make this condition clear when introducing any future QE program. Ideally, the exit condition should be closely related to the outlook for inflation. The condition should also be coherent with any condition used for starting normalization and ending forward guidance, since these measures are also related to the inflation-control target mandate. When announcing its GBPP program, the Bank said it would continue purchases "until the economic recovery is well underway," but this left a lot of room for interpretation.[60] When it stopped the GBPP, it said it would not consider balance sheet normalization until it began raising interest rates. Part of the motivation for the careful exit from the GBPP and the start of normalization was to avoid a potential "taper tantrum," where interest rates increase quickly.

Exit conditions for the different extraordinary tools will have implications for the sequencing of exits from those tools. Should the exit conditions and communication of the future timing of QE be intertwined or separated from the exit conditions and communication of the future timing of forward guidance? If the tools have the same monetary policy goal, should they have related exit conditions? If they have related exit conditions, does this imply an optimal sequencing of those tools? How does the sequencing of tools vary in different economic environments? These are complex questions that warrant further analysis.

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57 See Vayanos and Vila (2021) and Ray (2019).

58 See Santor and Suchanek (2016) and Reza, Santor and Suchanek (2015).

59 In the past, other central banks have communicated a total size for the QE program (stock) instead of a weekly amount (flow). Levin, Lu and Nelson (2022) argue that communicating QE as a flow amount instead of as a total program size could unduly lengthen how long QE lasts.

60 See Bank of Canada (2020d).

5. Evaluating extraordinary forward guidance

Ordinary forward guidance is a central bank statement that provides *direct* information—beyond the central bank's macroeconomic forecasts—about the level of the policy interest rate in the future. In this sense, ordinary forward guidance is a forecast. Central banks often provide ordinary forward guidance in the normal course of their business. Some central banks (for instance, the Reserve Bank of New Zealand, Sweden's Riksbank and Norway's Norges Bank) release a projected path for their policy interest rate. The Bank of Canada, like many other central banks, often provides verbal information about the future policy interest rate.[61] In its press releases and opening statements accompanying its interest rate decisions, the Bank at times provides an indication of the expected direction of future policy interest rate movements. More recently, the Bank's Governing Council has explained in its *Summary of Deliberations* the policy interest rate options it discussed at each interest rate decision.

Extraordinary forward guidance (EFG) sends a stronger signal than ordinary forward guidance. EFG is deployed when central banks want to signal that the policy interest rate will stay at its ELB for an extended period. EFG operates in two main ways to enhance the transmission of monetary policy:

- It lowers future interest rate expectations if market expectations differ from the policy interest rate path signalled by EFG.
- It reduces uncertainty about the interest rate path.

Through these two mechanisms, EFG encourages household consumption and business investment. This should reduce economic slack in the economy and help a central bank steer inflation back toward its target.

EFG may indicate a commitment to some future state of monetary policy.[62] For advanced economies, this has largely been a commitment to hold the policy interest rate at the ELB for an extended period, with the length of time being conditional on some state of the economy. The Bank of Canada first used EFG with a conditional

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61 For more background and details on these concepts in the context of the pandemic in Canada, see Gravelle and Sutherland (forthcoming).

62 Central banks do not provide *binding* commitments on the future state of monetary policy. Even when central banks use this strong, commitment-based language, forecasters and market participants implicitly understand that any such commitment is conditional on the inflation outlook. Indeed, central banks should always stress this conditionality. See Sutherland (2023, 227).

commitment in April 2009, and other central banks have used EFG with a conditional commitment only occasionally.[63]

How and when was extraordinary forward guidance deployed in Canada?

The Bank of Canada deployed EFG to signal that the policy interest rate could stay at the ELB for an extended period. As discussed in section 2, the Bank's EFG contained an outcomes-based commitment conditional on the absorption of economic slack and inflation returning to target. The Bank also started to provide an estimate linked to the staff forecast of when slack would be absorbed. The timing of the absorption of slack was moved forward several times to reflect changes to the forecast. Separating the outcomes-based commitment from the estimate of when economic slack would be absorbed allowed the Bank to maintain its commitment while also adapting to economic conditions. The Bank ended EFG in January 2022 because it deemed that economic slack was absorbed.

What is the evidence that extraordinary forward guidance worked?

The financial market impact of extraordinary forward guidance

EFG is rarely used, and few studies look at the effects of EFG alone. But EFG is stronger than ordinary forward guidance, and the evidence strongly suggests that ordinary forward guidance does have an influence on the level of interest rate expectations.[64]
In Canada, there have been two episodes of EFG: in 2009–10 and in 2020–21. Bank of Canada research finds that the effect of EFG in 2009–10 was much stronger than that of ordinary forward guidance. The same is true of the EFG used in Sweden in 2014–15.[65]

When the Bank introduced EFG on July 15, 2020, there was little movement in interest rates. Because the policy interest rate was already at the ELB and the Bank had initiated QE, expectations for the future policy interest rate were already low. That is, both market-implied and professional forecaster expectations for the level of the policy interest rate over the next year and beyond were near the ELB. So, in this instance, by

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63 See sections 2.3.1 and 5 in Sutherland (2023) for details, background and empirical work on commitment-based forward guidance.

64 For the effect on market interest rates, see Hansen and McMahon (2016), Bauer and Swanson (2023), Altavilla et al. (2019), Kaminska and Mumtaz (2022), and Brubakk, ter Ellen and Xu (2021). For the effect on professional forecasts, see Sutherland (2023). Outside of the pandemic, Bank of Canada research has found that forward guidance influences both Canadian yields and the Canadian dollar. See Feunou et al. (2017); Sutherland (forthcoming); and Sekkel and Zhang (forthcoming).

65 See Table 1 in Sutherland (2023) for details.

the time the Bank introduced EFG, there was little room for it to feasibly affect the level of market interest rate expectations. Yet, even if the EFG could not affect market pricing when it was announced, it may have prevented interest rate expectations from rising after the announcement.

Just as important, research has also found that EFG can reduce uncertainty about the future level of interest rates. A Bank research study finds that interest rate uncertainty decreased following major policy actions in Canada, including the EFG, that the Bank took in response to the 2007–09 global financial crisis.[66] International studies also find that ordinary forward guidance reduces interest rate uncertainty, as judged by various proxies. One study shows that market interest rates become less responsive to macroeconomic news when stronger forms of forward guidance are used.[67] Another study finds that professional interest rate forecasts become closer to each other following forward guidance, and that these forecasts become better predictors of future interest rates.[68]

The macroeconomic impact of extraordinary forward guidance

EFG can affect household and business interest rate expectations, and therefore activity. EFG likely reduced uncertainty about future rates, which may have stimulated demand.

To evaluate the macroeconomic impact of EFG requires comparing what actually happened in the economy with what *would have* happened had EFG not been there. To do so, Bank staff determine what the policy interest rate paths would have been based on the Bank's historical policy interest rate rule.[69] This is done using real-time staff projection vintages of output and inflation at the time of the publication of each quarterly *Monetary Policy Report*. By design, these alternative policy interest rate paths reflect the data available at the time of each interest rate decision as well as the staff judgment and assumption at each decision. They are intended to proxy what market expectations of interest rates would have been in the absence of EFG. With this exercise, the alternative policy interest rate path at each vintage is not significantly higher than the policy interest rate path in the staff forecasts (which incorporated forward guidance).

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66 See Chang and Feunou (2014).

67 See Ehrmann et al. (2019).

68 See Jain and Sutherland (2018).

69 This is done by removing the judgment in the policy rule introduced to implement forward guidance in the projection. The analysis starts with the January 2021 vintage because staff did not implement specific forward guidance judgment before October 2020.

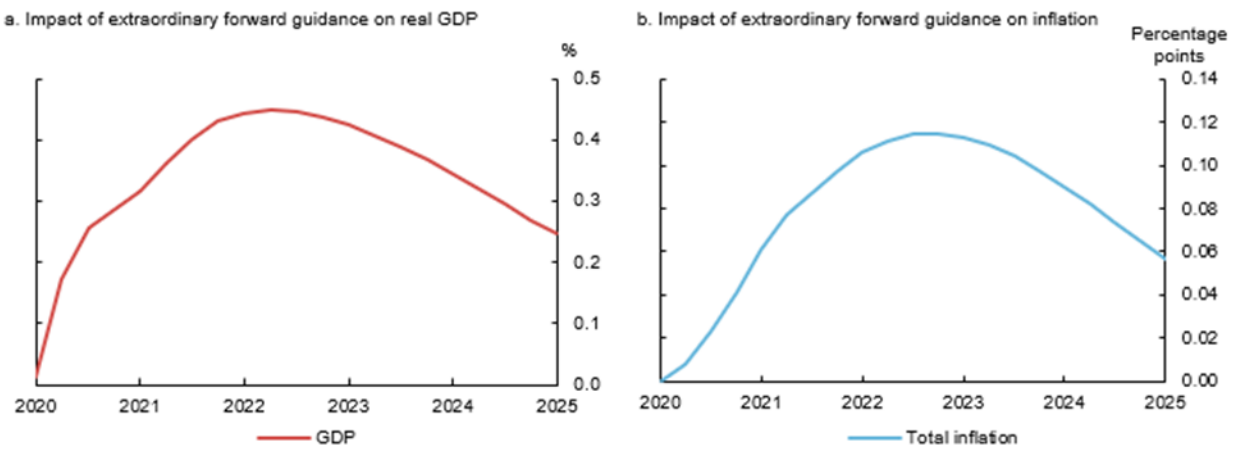
This suggests that the market would have expected rates to remain at the lower bound for a similar duration without EFG.

Following the historical interest rate rule, the Bank would have hiked the policy interest rate by the fourth quarter of 2021, at the earliest, rather than in the first quarter of 2022. This is because staff did not expect a rapid economic recovery or a surge in inflation. As a result, this exercise suggests that the effect of the Bank's EFG was modest: the level of GDP was 0.4% higher at its peak (at the end of 2022), and inflation was 0.1 pp higher at its peak than it would have been without EFG (**Chart 14**).[70] Similarly, in a recent study by the European Central Bank, researchers perform a similar exercise. Evaluating monetary policy using real-time quarterly vintages of incoming data and projections, they find that alternative interest rate paths would have been broadly consistent with the observed monetary policy (i.e., an interest path consistent with the European Central Bank's EFG). Thus, the macroeconomic outcomes would also have been broadly similar.

These exercises, however, likely underestimate the true impact of EFG because they exclude the impact on the macroeconomy of removing uncertainty and the upside risk to interest rates.

Chart 14: Extraordinary forward guidance had a small impact on real GDP and inflation

Quarterly data



Sources: Statistics Canada and Bank of Canada calculations, estimates and projections

Last data plotted: 2025Q4

70 These numbers represent the cumulated stimulus provided by EFG. They are based on a simulation using the LENS model, in which the EFG stimulus is updated at each quarter recursively and corresponds to the difference between the policy interest rate paths obtained with the historical policy rule and ones embedded in the *Monetary Policy Report* forecasts.

What were the risks and unintended impacts of extraordinary forward guidance?

Under EFG, the central bank communicates how it could deviate from its normal policy interest rate rule in the future. When the economy begins to improve, EFG may put the central bank in a position where it needs to decide between maintaining its prevailing EFG and ending EFG early to return to the central bank's normal policy interest rate rule. Either decision could introduce a risk to the central bank.

On the one hand, the central bank may lose credibility if it is perceived to have exited its EFG early. For EFG to work as intended, the central bank must be credible. A perceived early exit—a raise in the policy interest rate sooner than expected—could reduce the credibility of the central bank's EFG in a future crisis. However, since ordinary forward guidance and EFG are always conditional on the inflation outlook, one could argue that the risk of losing flexibility in setting the policy interest rate may not be that restrictive because the central bank would still be able to raise rates later as needed to respond to an expected inflation outlook. What happens after EFG is removed matters for public perception and credibility. Arguably, Canadians were less concerned about the timing of the removal of forward guidance and more concerned with the size and pace of interest rate increases afterward.

On the other hand, keeping the policy interest rate low to maintain a perceived commitment may contribute to excess inflation. When EFG is not outcome-based, a central bank could feel compelled to keep the policy interest rate low to preserve the credibility of its EFG. In that case, its policy interest rate may not be tightened as quickly as necessary to deal with inflationary pressures. Other central banks have discussed having to handle this tension in the latter stages of the pandemic.[71]

EFG can be difficult to communicate clearly. For EFG to work well, it needs to be understood by a broad audience—ideally including both the financial markets and the general public. Developing communication that is clear to both audiences is challenging. Central banks therefore often adjust or simplify the wording, particularly to make it clearer and more accessible to a broader audience. In addition, the central bank's EFG communication is often further simplified or interpreted by the media and by people providing financial advice. This can very easily lead to the public understanding or

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71 See Arnold (2023).

interpreting the guidance in ways the central bank does not intend. When a central bank does not follow what it is perceived to have said, this can be seen as a broken promise.

What could the Bank do differently if it used extraordinary forward guidance again?

If the Bank were to use EFG in the future, it would likely again take an outcome-based approach, using an economic condition rather than a fixed time frame. Because the Bank used an economic condition in its EFG during the pandemic, the timeline adjusted automatically as the economic outlook shifted. In contrast, when guidance is tied to a specific time horizon, the forward guidance does not adjust automatically as the outlook shifts, and this can become problematic. In a crisis, the economic outlook may change rapidly. It would not be helpful for markets and the public to have the central bank frequently changing its EFG language. Outcome-based EFG has clear advantages over time-based EFG (as well as over vague or unconditional commitments); nevertheless, the Bank would likely make some adjustments to how its EFG is communicated and implemented.

In future episodes, the Bank should constantly stress the outcome-based nature of EFG in all Bank communications. Because EFG is a policy tool that works through communicating the Bank's future policy stance, clear and effective communication is crucial. Therefore, even after the initial announcement, the Bank continued to reinforce its EFG message through further communications, such as speeches, press conferences and its quarterly *Monetary Policy Report*. The majority of these communications reiterated the conditionality of the EFG. However, to reach a broader audience of Canadians, the Bank's EFG was simplified on some occasions, leaving out the conditionality. Canadians were told they could be confident that rates would be low for a long time. In the future, the Bank should be consistent in stressing the conditionality in all its communications.

Future EFG should consider being more explicitly conditional on the outlook for inflation. In many instances, absorption of economic slack (e.g., an output gap close to zero) may be necessary and sufficient to sustainably achieve the inflation target. However, the post-pandemic recovery serves as an important reminder that inflation can emerge even when economic slack is not fully absorbed (see **Box 2**). Large and persistent supply shocks can drive a positive wedge between inflation and traditional measures of economic slack. For this reason, it may be preferable to make EFG conditional on the Bank's assessment of current or expected inflation pressures rather

than on slack alone. This doesn't preclude slack as an important factor—rather, it acknowledges that other factors can also influence inflation pressures.

Questions also remain about the design of EFG and how best to specify conditions for exit. Under what circumstance would it be better to condition EFG on observable or unobservable variables? When should the exit condition be based on economic forecasts? On the one hand, linking the exit of EFG to an observable variable (e.g., consumer price index inflation) makes the timing of the exit easy to understand and verify, but it also makes that timing depend on the volatility of the variable it is based on. On the other hand, conditioning the exit of EFG on an unobservable variable, such as economic slack, introduces a lack of precision in measurement. Moreover, the noise in measurement could be larger during a crisis like the pandemic—the precise time when EFG is most likely to be deployed. Another issue is whether or when the exit of EFG should be based on economic forecasts. Conditioning on forecasts makes the EFG more dynamic because a central bank can update the timing of the exit along with its forecasts. However, this also makes the timing of exit a moving target, which could create more challenges for communication.

6. Summary

The health and economic impacts of the COVID-19 pandemic shock were unprecedented in our lifetime. In the face of major risks to the economy, the Bank lowered its policy interest rate to the effective lower bound of 0.25%. It launched a range of liquidity facilities and purchase programs to restore market functioning. When the functioning in financial markets normalized, the Bank wound down most of its market functioning programs. In addition to using its primary monetary policy tool—its policy interest rate—the Bank also deployed exceptional monetary policy tools—namely, quantitative easing and extraordinary forward guidance. These exceptional tools provided additional monetary support to the Canadian economy. Both employment and GDP growth recovered from their lows and the economy avoided severe negative outcomes. All this was achieved in the face of extreme economic uncertainty.

This review has assessed the effects of the Bank's extraordinary pandemic policy actions with the benefit of hindsight. A high level of uncertainty is inherently associated with any estimates of the effectiveness of the policy tools the Bank used. Nonetheless, several lessons can be drawn from this experience that will be invaluable in shaping policy decisions in the future.

7. Appendix: Bank of Canada's asset purchase programs and facilities

Program name	Objective	Initial announcement	Start–end dates	Initial size	Actual total size (Can$ billions)
Extended term repo facility	To support commercial bank funding conditions	March 12, 2020	March 17, 2020–May 10, 2020	No pre-set maximum for the aggregate program size	215.0
Bankers' Acceptance Purchase Facility	To support the continuous functioning of financial markets	March 13, 2020	March 23, 2020–October 26, 2020	No pre-set maximum for the aggregate program size	47.1
Canada Mortgage Bond Purchase Program	To support the Canada Mortgage Bond market and the ability of financial institutions to finance mortgage lending to homeowners	March 16, 2020	March 17, 2020–October 29, 2020	No pre-set maximum for the aggregate program size	8.0
Provincial Money Market Purchase Program	To support a liquid and well-functioning market for short-term provincial borrowing	March 24, 2020	March 25, 2020–November 16, 2020	40% of each offering of directly issued provincial money market securities; no pre-set maximum for the aggregate program size	12.4
Government of Canada Bond Purchase Program	Initially, to address strains in the Government of Canada bond market and to enhance the effectiveness of other actions taken to support core funding markets. As of June 2020, to provide additional monetary policy stimulus.	March 27, 2020	April 1, 2020–October 27, 2021 (end of net new purchases)	Initial target size of a minimum of $5 billion in purchases per week; no pre-set maximum for the aggregate program size	339.2 Note: total program size for all phases

Commercial Paper Purchase Program	To support the flow of credit to the economy by alleviating strains in commercial paper markets	March 27, 2020	April 2, 2020–April 2, 2021	No pre-set maximum for the aggregate program size	3.6
Contingent Term Repo Facility	To counter any severe market-wide liquidity stresses and support the stability of the Canadian financial system	March 20, 2020	April 6, 2020–April 6, 2021	No pre-set maximum for the aggregate program size	0.1 Note: Amount outstanding as of April 30, 2020
Incremental Government of Canada treasury bill purchases	To support continued liquidity and efficient functioning of the federal government's treasury bill program	April 15, 2020	April 21, 2020–November 24, 2020	Purchases increased from the typical 25% of each auction to a maximum of 40%; no pre-set maximum for the aggregate program size	151.7
Provincial Bond Purchase Program	To support the liquidity and efficiency of provincial government funding markets (supplements the Provincial Money Market Purchase Program)	April 15, 2020	May 7, 2020–May 7, 2021	Up to $50 billion	17.6
Corporate Bond Purchase Program	To support the liquidity and proper functioning of the corporate debt market	April 15, 2020	May 26, 2020–May 26, 2021	Up to $10 billion	0.3

8. Glossary

Effective lower bound (ELB): The ELB is the point at which further cuts in the policy interest rate no longer provide monetary stimulus to the economy.

Extraordinary forward guidance (EFG): Forward guidance is a central bank statement that provides direct information about the level of the policy interest rate in the future. EFG uses a commitment, signals an expectation that the policy interest rate will stay at its lower bound for an extended period, or signals that new, atypical information will be incorporated directly into the central bank's interest rate policy rule.

Government Bond Purchase Program (GBPP): The Bank introduced the GBPP in March 2020 to "address strains in the Government of Canada debt market and to enhance the effectiveness of all other actions taken so far" (Bank of Canada 2020d). In this program, the Bank was initially purchasing at least $5 billion of federal government bonds per week. The purpose of the program transitioned in June 2020 to providing monetary stimulus. GBPP purchases ended in October 2021 when Governing Council judged that "…the economic recovery was well underway."

Quantitative easing (QE): Under QE, a central bank buys government bonds. Buying government bonds raises their price and lowers their return—the rate of interest they pay to bondholders. This rate of return is also known as the bond's yield. Under QE, the central bank buys bonds in the open market from financial institutions. And the funds that it uses to pay for these purchases end up being deposited in accounts that financial institutions have at the central bank in the form of settlement balances.

Quantitative tightening (QT): QT can be thought of as the reverse of QE: the central bank unwinds its QE purchases, and the risks of those assets are removed from its balance sheet and put back in the hands of market participants. QT can be passive, whereby the central bank allows the bonds on its balance sheet to mature without reinvesting the proceeds from the bond maturity in other bonds. Alternatively, QT could be active, whereby the central bank sells some of its government bond holdings.

Settlement balances: Settlement balances can be defined as interest-bearing deposits that belong to participants of Canada's payment system. These balances, known as *reserves* in other jurisdictions, are held overnight at the Bank of Canada and are remunerated at the Bank's deposit rate. They are reflected as a liability on the Bank's balance sheet.

Taper tantrum: A taper tantrum is a sharp increase in bond yields caused by investor reactions to a central bank's announcement of plans to reduce future bond purchases.

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