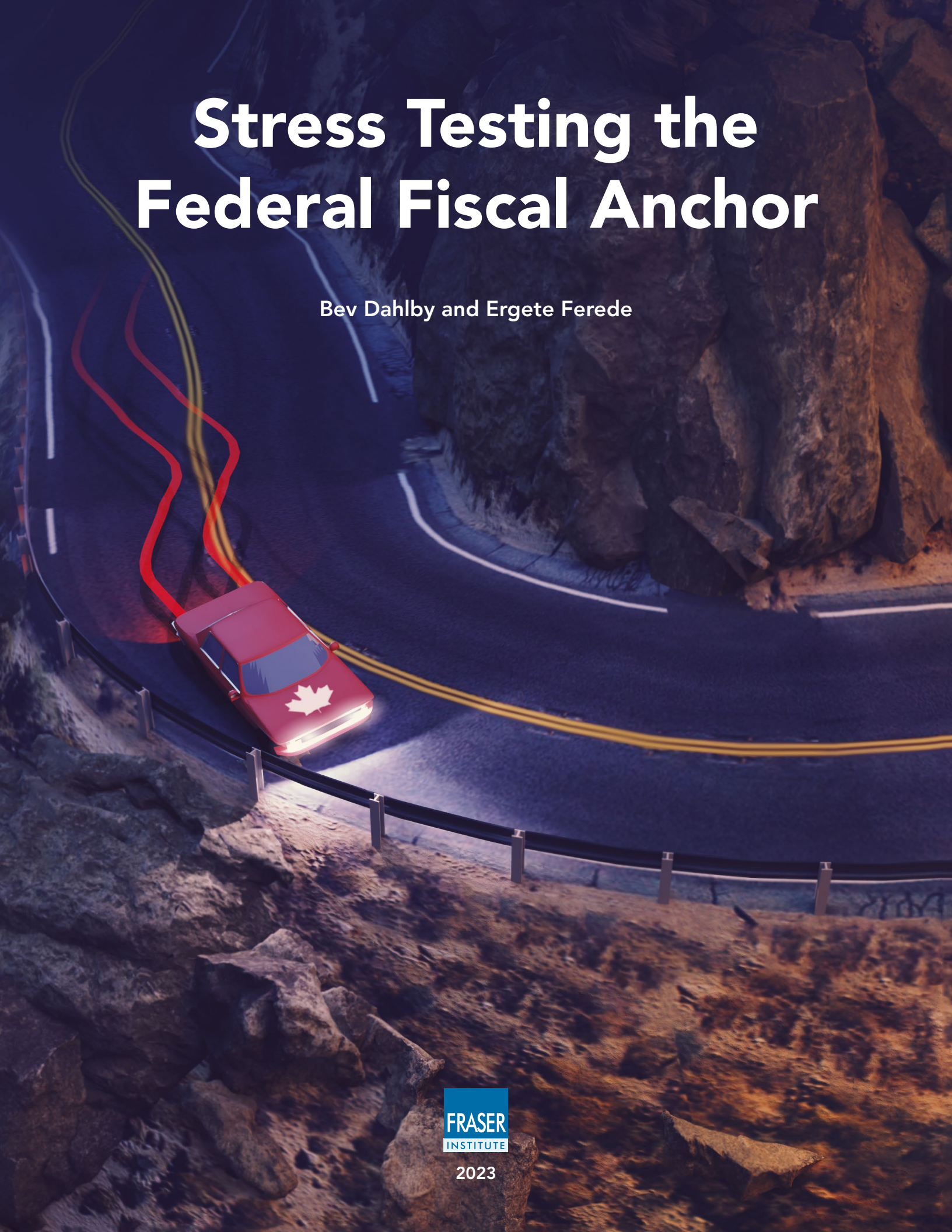
Stress Testing the Federal Fiscal Anchor

Bev Dahlby and Ergete Ferede



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Executive Summary

Prior to the pandemic, the federal government's fiscal anchor was to maintain its debt-to-GDP ratio at 30%. But then, with federal borrowing to finance the massive increase in pandemic-related spending, the debt ratio shot up to 47.5% in 2021. Rather than adopt the fiscal restraints necessary to return the debt ratio to its previous target, the federal government has embraced a new fiscal anchor—gradually reducing the federal debt-to-GDP ratio over the medium term—with no explicit target ratio or timetable. Although it has adopted a very accommodating goal, the federal government argues that a declining debt ratio will provide the "fiscal room" to deal with future fiscal challenges arising from recessions, new pandemics, and geopolitical risks. To demonstrate its commitment to its new fiscal anchor, the federal government has projected a steadily declining debt-to-GDP ratio over the next 45 years, assuming a constant annual economic growth rate of 1.6%. However, the assumption that the economy will grow at a constant rate ignores our historical experience—that the Canadian economy will experience one or more recessions in the coming decades.

It is important to evaluate how major economic downturns could affect the public debt. Negative economic shocks increase public debt directly, because government revenues decline and some public expenditures may increase, leading to larger budget deficits (or reduced surpluses), and indirectly over time through higher real interest rates on government debt and slower economic growth rates as public-sector debt increases. The direct and indirect effects of a recession could set off a debt "doom loop", with the debt ratio spiraling upward if the government does not quickly respond by reducing its post-recession budget deficits.

In order to provide a realistic assessment of the federal government's multi-year fiscal plan, we use a Monte Carlo simulation model to investigate how the federal government's debt ratio might evolve if the Canadian economy is subject to random growth-rate shocks similar to those experienced over the last 40 years. The model generates 1,000 episodes of the evolution of the federal net-debt ratio over a 20-year time horizon when the economy is subject to annual growth-rate shocks. It indicates that there is a 30% chance that the federal debt-to-GDP ratio will be higher over a 10-year time horizon and a 53% chance that it will be higher over a 20-year time horizon. The likelihood of no recessions occurring over a 20-year time horizon is only 15%. This means that it is

very unlikely that the federal projected debt ratios will be realized. In other words, taking the federal government's projected primary surpluses at face value, but with random shocks to the growth rate that mimic past experience, the federal fiscal anchor will most likely be violated. The probabilities of one, two, and three or more recessions over a 20-year time horizon are 32%, 28%, and 25%, respectively. When two recessions occur, there is a 60% chance that the debt ratio will increase.

What are the policy implications of taking the likelihood of future recessions seriously? Clearly, a government's fiscal policy should not be so restrictive that it entirely eliminates the possibility of an increase in the debt ratio after a downturn in the economy. Nonetheless, we argue that the federal government should adopt a more restrictive fiscal policy to reduce the likelihood that the federal debt ratio will increase in the future. Our model indicates that, if the federal government increased its projected primary budget surplus to 2% of GDP, the probability of an increasing debt ratio would drop to around 20%. As demonstrated in our recent publication, *An Evaluation of Three Alternative Fiscal Anchors for Canada*, (Dahlby, Ferede, and Fuss, 2022) and consistent with the conclusion reached by Alesina, Favero, and Giavazzi in their pioneering book, *Austerity: When It Works and When It Doesn't* (2020), the best way to lower budget deficits and public debt is through restraint of public-sector expenditures.

1. Introduction

A fiscal anchor is a policy that constrains a government's fiscal choices affecting debt, deficits, expenditures, or interest payments. The federal government's current fiscal anchor is to reduce the federal debt-to-GDP ratio over the medium term (Canada, Department of Finance, 2022c: 22). In its *Fall Economic Statement*, the federal government provided the following rationale for adopting this fiscal anchor:

> Keeping the federal debt-to-GDP ratio on a downward trend over the medium and longer term will help ensure that future generations are not burdened with debt and that fiscal room remains available to face future challenges and risks that are not accounted for in this projection. These include, among others, climate change, the transition to net-zero, recessions, new pandemics, and geopolitical risk. (Canada, Department of Finance, 2022a: 58)

The degree of uncertainty and heightened risks is, in the opinion of some commentators, unprecedented. The former Secretary of the US Treasury, Lawrence Summers, recently remarked: "This is the most complex, disparate, and cross cutting set of challenges that I can remember in the 40 years I've been paying attention to such things" (Lynch, 2022). Tooze (2020) refers to these entangled economic and non-economic risks as a polycrisis.

In spite of both known and unknown risks to the world economy, the federal government is projecting a steadily declining federal debt-to-GDP ratio over the next 45 years, assuming a constant annual economic growth rate of 1.6%, based on an annual labour-supply growth rate of 0.6% and 1.0% labour productivity growth (Canada, Department of Finance 2022a: 59). The assumption that the economy will grow at a constant 1.6% rate, however, does not take into account "climate change, the transition to net-zero, recessions, new pandemics, and geopolitical risk", which all represent major downside risks for the Canadian economy in the coming decades.[1]

Do current federal fiscal policies ensure that the debt ratio will decline in view of these challenges and risks? In the past, government debt has increased during economic downturns as revenues declined and some expenditures, such as employment insurance, increased. In the future, recessionary shocks will increase budget deficits and ratchet up

1. Commentators, such as Andrew Coyne (2023), are skeptical that the federal government will stick to its fiscal plan. Dodge and Dion (2023) have shown that federal debt ratio could rise if federal spending increases to meet its policy goals, there is a recession in 2023, and interest rates are higher in the future.

public debt. Although it is impossible to forecast the size and timing of future economic downturns, the past provides some indication of the frequency of recessions and their impact on governments' finances. Since 1980, the Canadian economy has been subject to four "recession shocks"—1982, 1991, 2009, 2020— in which real GDP declined by, on average, 3.0%. Is the federal fiscal policy resilient enough to deliver a declining debt-to-GDP ratio if we experience similar economic shocks in the future?

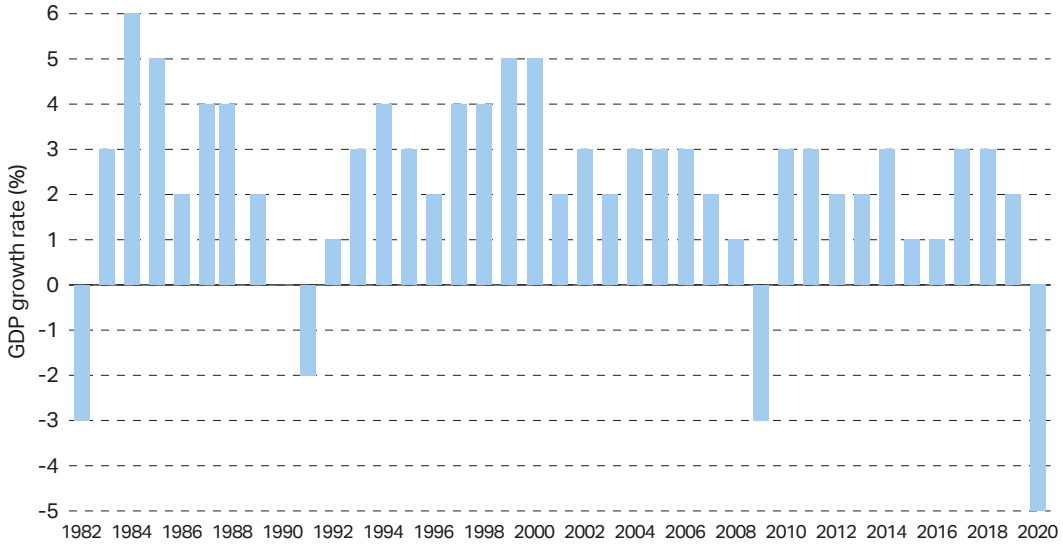
In this study, we use a Monte Carlo simulation model (see Appendix 1) to investigate how the federal government's debt might evolve if the Canadian economy is subject to random growth shocks similar to those experienced over the last 40 years. The model generates 1,000 episodes of how the debt ratio would evolve over a 20-year time horizon and shows that there is a 30% chance that the federal debt-to-GDP ratio will be higher in 2037 than in 2027 and a 53% chance that it will be higher in 2047 than in 2027. In other words, taking the federal government's projected primary surpluses at face value, but with random shocks to the growth rate using what many would regard as optimistic assumptions about the likelihood of future recessions, we find that there is high probability that the federal debt ratio will increase. Accordingly, a more prudent fiscal policy, based on lower federal spending, is recommended to reduce the likelihood of a higher federal debt ratio in the future.

The study is organized as follows. In section 2, we describe the fluctuations in the growth rate that have occurred over the past 40 years, noting in particular the impact that recessions have had on budget deficits and debt levels. (Appendix 1 provides more detail on the how we incorporate both "normal" fluctuations in the growth rate and recessionary shocks in our Monte Carlo model. Appendix 2 contains the parameter estimates from the econometric models of the interactions between these fiscal and economic variables that are vital components of the Monte Carlo model.) In section 3, we describe the key components of the federal net debt and the trend in the federal net debt-to-GDP ratio over the last 40 years. We show how changes in effective interest rates on federal debt, the nominal GDP growth rate, and the ratio of primary budget balances to debt have contributed to increases or reductions in the debt-to-GDP ratio. Section 4 provides an overview of the key equations of the Monte Carlo model and summarizes the main results from the simulations. The last section is a brief summary of the results and policy recommendations.

2. The Fiscal Impacts of Economic Shocks

The most striking aspects of the fluctuations in Canada's GDP growth rate since 1982 are the recessions in 1982, 1991, 2009, and 2020, when aggregate output declined on average by 3% (**figure 1**). These "recession shocks" have occurred roughly once every 10 years over the past 40 years.[2] Importantly, we do not observe any offsetting large positive shocks to the growth rate. Any model of shocks to the growth rate should reflect the asymmetric nature of the shocks because the recessions pose a significant downside risk to the country's finances that should be reflected in prudent fiscal policies. The fluctuations in the growth rate can be decomposed into the recession shocks and the "normal" annual random shocks. Appendix 1 explains how these two types of growth rate shocks are calculated and incorporated in our Monte Carlo simulation model.

Figure 1: Canada's annual real GDP growth rate (%), 1982–2020



Source: Statistics Canada, 2023b.

Negative economic shocks increase public debt directly, because governments' revenues decline and some public expenditures may increase, leading to larger budget deficits (or reduced surpluses), and indirectly through higher real interest rates on government debt and slower economic growth rates as public-sector debt increases. The direct and indirect effects of a recession shock could set off what Lawrence Summers has

2. There is no universally accepted definition of a recession. In this study, a recession is a year in which real GDP declined.

called a debt "doom loop" with the debt ratio spiraling if a government does not quickly reduce its budget deficits (Anstey, 2022). The possibility that negative economic shocks could set off a debt doom loop is why it is important to assess governments' fiscal policies using a Monte Carlo simulation model.

While the direct effect of a growth-rate shock on public-sector primary budget balances and debt is significant and widely understood, the indirect effects are less widely recognized. Studies have shown that higher public-sector debt ratios are associated with higher real interest rates on government debt.[3] The positive relationship between higher public-sector debt and higher interest rates implies that a negative growth rate shock in one year can lead to higher budget deficits in subsequent years because of higher interest payments. Studies also indicate that higher public-sector debt ratios are associated with lower long-run economic growth rates. For a given primary budget balance, a slower growth rate implies that the ratio of public debt to GDP will increase at a faster rate.

Appendix 2 (pp. 19–27) contains econometric models of the interactions between these fiscal and economic variables. We first investigate how economic growth shocks affect the federal government's primary balance-to-GDP ratio using an empirical methodology similar to those of previous studies. Our empirical analysis reveals a positive relationship between economic growth shocks and the primary balance-to-GDP ratio. The results suggest that a one percentage-point growth shock is associated with a rise in the primary budget balance equalling 0.545% of GDP. The share of the population over age 65 also has a significant negative effect on federal primary surpluses in the regression model. As well, a dummy variable equal to one if the prime minister belongs to the Liberal Party and zero otherwise has a negative and significant coefficient. Since we want to test whether the federal government's projected primary surpluses are consistent with a decreasing federal debt ratio, we do not include the effect of population aging or the political party in power on the projected primary balances in the Monte Carlo simulation model.

We also investigate how the federal government's net debt-to-GDP ratio affects the real rate of return on long-term government bonds. According to our estimate, a ten percentage-point increase in the federal government net debt-to-GDP ratio is associated with an increase in the real long-term interest rate by about 51 basis points. We also

3. See Dahlby, Ferede, and Fuss, 2022 for reviews of the literature on the effects of public debt on interest rates and growth rates.

estimated regression models of the impact of higher public debt on the growth rate of the economy. As table A2.4 (p. 26) indicates, an increase in the growth rate of the debt ratio is associated with a decline in the real GDP per-capita growth rate. Unfortunately, because of the complexity of this relationship—the GDP growth rate depends on the growth rate of the debt ratio, not its level—we were not able to incorporate this potentially important positive feed-back effect in the simulation model.

3. The Composition and Evolution of the Federal Debt

The federal debt increases from one fiscal year to the next when its total revenues are less than the interest payments on its existing debt plus its other non-interest expenses, such as transfers to individuals, businesses, and other levels of government, the salaries of federal public servants, purchases of goods and other services, and so on. To finance a gap between its total revenues and its interest and non-interest expenses, the government borrows by issuing bonds and Treasury bills. The other liabilities of the federal government include its accounts payable and an estimate of its liability for future public pensions payments and other benefits.

The main components of the federal government's total liabilities of $1.389 trillion are shown in **table 1**. Accounts payable and accrued liabilities represent 14.2% of total liabilities. The other components—marketable bonds, Treasury Bills and other debt, 68.1% and its liability for future pensions and other benefits for federal employees, 17.8%—are referred to as interest-bearing debt in the Public Accounts.

Table 1: Federal liabilities, financial assets, net debt and accumulated deficit in 2022

	Millions of dollars	Percentage of total		Millions of dollars	Percentage of total
Accounts Payable and Accrued Liabilities	260,288	14.2	Cash and Accounts Receivable	280,026	46.6
Marketable Bonds and Treasury Bills	1,218,277	66.3	Loans, Investments, and Advances	207,031	34.5
Other Debt	32,721	1.8	Foreign Exchange Accounts	104,031	17.3
Pensions and Other Future Benefits	327,371	17.8	Public Sector Pension Assets	9,203	1.5
Total Liabilities	**1,838,657**	**100.0**	**Total Financial Assets**	**600,291**	**100.0**
Net Debt	1,238,366				
Non-Financial Assets	103,873				
Federal Debt	1,134,493				

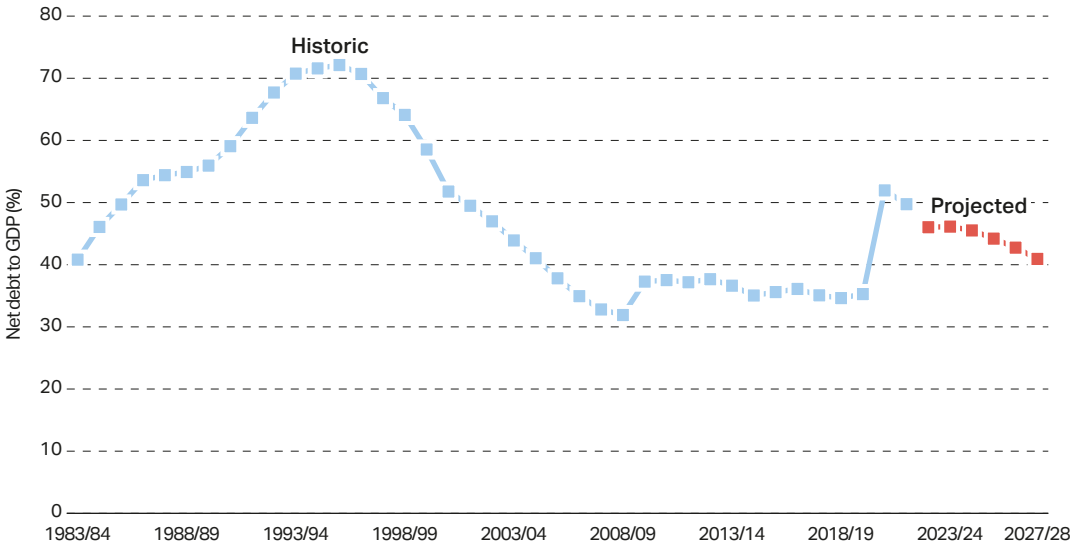
Source: Canada, Department of Finance, 2022c: table 1.2, p. 42.

Offsetting these liabilities, the federal government had financial assets of just over $600 billion, consisting of cash and accounts receivable—46.6% of the total—loans, investments and advances, 34.5%, the value of foreign exchange accounts, 17.3%, and public-sector pension assets, 1.5%. The difference between the federal government's liabilities and its financial assets is its net debt, which stood at $1.24 trillion dollars as of March 31, 2022. By deducting the value of the federal government's non-financial assets (primarily land and buildings) of $103.9 billion from its net debt, we arrive at the total federal debt, or the accumulated deficit as it is referred to in the public accounts, of $1.134 trillion.

For the average Canadian, the federal debt is an incomprehensibly huge number. To put the debt in perspective, it is conventional to express it as a percentage of GDP as this provides one way of comparing government debt to the economy's ability to support it. While the federal government's fiscal anchor is based on a decline in ratio of the total federal debt to GDP, we will focus on the net debt because non-financial assets represent a small adjustment to the total debt and a relatively constant share of Canada's GDP, about 4%, in recent years. We will refer to the ratio of the federal net debt to GDP as the "debt ratio".

Figure 2 shows that the ratio of the federal net debt to GDP from 1983/84 to 2021/22 as well as the debt ratios projected by the federal government in the Fall Economic Statement 2022 (Canada, Department of Finance, 2022a). The evolution of the debt ratio since 1983/85 can be divided into three distinct periods. First, from 1983/84 to 1995/96, the debt ratio increased, peaking at 72.1%. By that point, Canada's foreign currency debt had been downgraded by the bond rating agencies. The *Wall Street Journal* called Canada "an honorary member of the Third World" and suggested that Canada would need financial support from the IMF. In the wake of these gloomy assessments of Canada's fiscal policies, the Chretien government cut spending to balance the federal budget (Clemens, Palacios, and Veldhuis, 2017). With the fiscal restraint policies, combined with low interest rates and robust economic growth, the debt ratio steadily declined to 31.9% in 2008/09. There was an up-tick in the debt ratio in 2009/10 because of the Great Financial Crisis. From 2014/15 to 2019/20, the debt ratio was stabilized at around 35% (Canada, Department of Finance, 2022b). The debt ratio then shot up to 52% in 2020/21 as a result of federal borrowing to finance the massive increase in pandemic-related spending (Canada, Department of Finance, 2022b). The *Fall Economic Statement* forecasts a steady decline in the net debt ratio to 40.9% in 2027/28 (Canada, Department of Finance, 2022a).

Figure 2: Ratio of the federal net debt to GDP in Canada, 1983/84–2027/28



Source: Canada, Department of Finance, 2022a, 2022b.

Why did the debt ratio increase until 1995/96, then decrease until 2008/09? Why was it stabilized after 2014/15 and why does the federal government project a decline in the debt ratio to 2027/28? To what degree were these trends in the debt ratio the result of federal fiscal policies or other factors that are largely beyond the control of the federal government?

It can be shown that the rate of change in the debt ratio, Δb, is determined by three factors—the effective interest rate on government debt, v, the growth rate of nominal GDP, n, and the ratio of the primary budget balance to the debt, π.[4] This relationship is shown in the equation below where the fourth variable, ε, is a residual that arises because of the approximations used in deriving this relationship:

$$\Delta b = v - n - \pi + \varepsilon \quad (1)$$

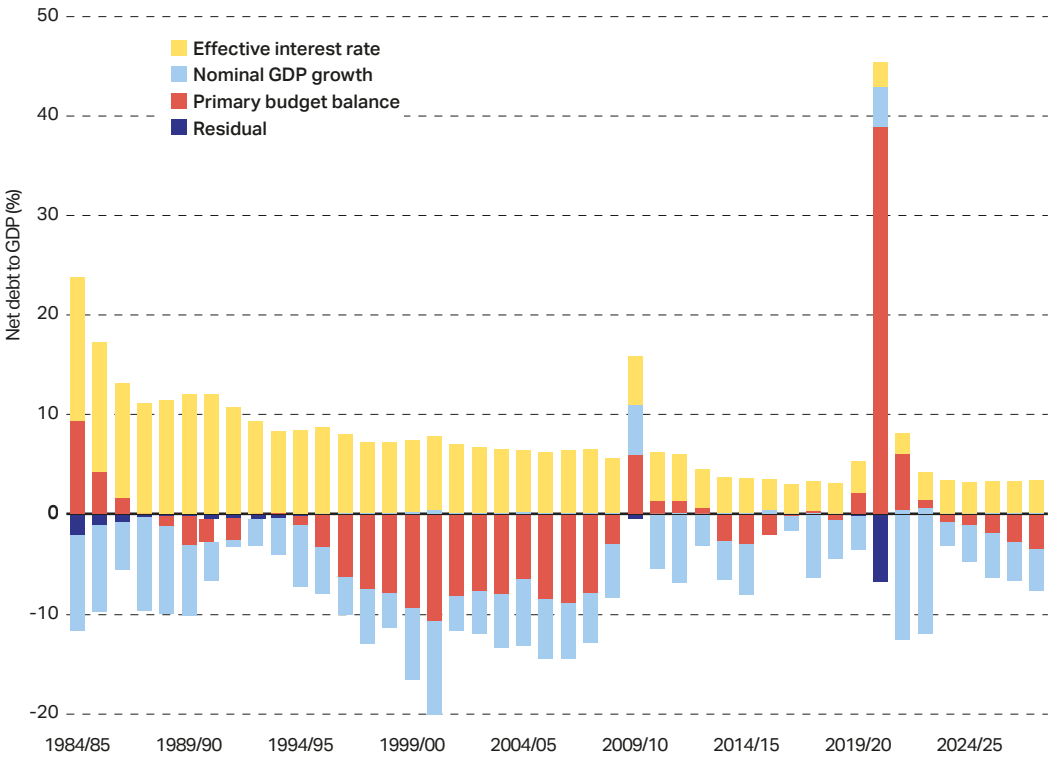
A higher effective (or average) interest rate on government debt increases the government's budget deficit, resulting in more borrowing and a higher debt level. On the other hand, when nominal GDP increases at a faster rate, the ratio of debt to GDP will tend to decline. Finally, a higher primary budget balance will reduce the deficit and the need to borrow and incur further debt. To illustrate these factors, suppose the effective interest

4. For the purposes of this study, the primary budget balance is the difference between the federal government's total revenues and its non-interest expense.

rate on government debt is 4% and nominal GDP is growing at 3%, then the debt ratio will remain (approximately) constant if the ratio of the primary surplus to debt is 1%. With a higher primary surplus, the debt ratio would decline, while a lower primary surplus ratio would result in an increasing debt ratio. Conversely, if the growth rate is 4% and the interest rate is 3%, the debt ratio will decline as long as the primary budget deficit ratio is not greater than 1% of the debt. Thus, it is important to recognize that the gap between the interest rate and the growth rate determines the primary surplus that the federal government has to run in order to reduce the federal debt ratio over time.

In **figure 3**, we use the relationships in equation (1) to show the contributions of each of these factors to the changes in the net debt ratio. Bars above (below) zero indicate a variable's contribution to the increase (decrease) in the debt ratio.

Figure 3: The contributions of the effective interest rate, nominal GDP growth rate, and primary budget balances to changes in the net debt ratio, 1984/85–2027/28



Sources: authors' calculations based on Canada, Department of Finance, *Fall Economic Statement 2022* (2022a) and *Fiscal Reference Tables* (2022b).

Figure 3 indicates that the debt ratio increased from 1984/85 to 1995/96 largely because the effective interest rate on federal debt was very high and the primary budget balance was either in deficit, from 1984/85 to 1986/87, or the primary budget surpluses were

small relative to the debt. The figure also indicates that the debt ratio started to decline after 1996/97 when the Chretien government attacked Canada's growing debt problem by substantially increasing its primary budget surpluses. The up-tick in the federal debt ratio in 2009/10 was due to a primary budget deficit and a decline in the nominal GDP. Subsequently, the debt ratio stabilized around 35% because the nominal GDP growth rate largely offset the (rather low) effective interest rate on federal debt. The federal government was therefore able to stabilize the debt ratio with primary budget balances close to zero. The increase in the debt ratio in 2020/21 was mainly due to the large primary deficit caused by the huge increase in pandemic-related spending. The federal government continued to run primary deficits in 2021/22 and 2022/23, but the debt ratio declined because of the increase in nominal GDP, a result in large part to the unanticipated burst of inflation in 2022. The figure also shows that the decline in the debt ratio to 2027/28 forecast by federal government in the *Fall Economic Statement* is based on projected increases in the federal primary budget balance, as well as nominal GDP growth rates that are forecast to exceed the effective interest rate on federal debt.

4. A Stress Test of the Federal Fiscal Anchor

Since the publication of his Presidential Address to the American Economic Association, Olivier Blanchard's analysis of fiscal policies in an era of low interest rates has been very influential in reducing concerns about the use of debt to finance government spending (Blanchard, 2019). In advising governments and international bodies on how to assess whether debt levels are too high, Blanchard notes that "Debt sustainability is fundamentally a probabilistic concept" (2023: chap. 1). In his view, the assessment of debt sustainability should be conducted using models that indicate how a government's debt ratio could evolve when subject to random fiscal and economic shocks in the future. A Stochastic Debt Sustainability Analysis (SDSA) can indicate the probability that a government's debt ratio will increase or decrease over time.[5] In this study, we perform an SDSA to indicate how the federal government's debt ratio could evolve if the Canadian economy is subject to random growth shocks similar to those experienced over the last 40 years.

What criterion should we adopt to decide whether the debt ratio is likely on a declining path, that is, consistent with the federal government's fiscal anchor? A similar question has recently arisen in the context of the European Commission's revision to its economic governance framework. The Commission will now assess whether a member country's fiscal policies are consistent with its Treaty obligations if its debt ratio is on a *plausible* downward path and its deficit is less than 3.0% of GDP as specified in the Growth and Stability Pact in 1997 (European Commission, 2022). There is no hard and fast rule for determining whether a declining debt ratio is plausible, but in their review of the EU Commission's revisions to its fiscal framework, Blanchard, Sapir, and Zettelmeyer suggest that "plausibly declining" should mean that there is an "80% or 90% probability that debt will remain on a declining path for 10 years" (2022). The Blanchard-Sapir-Zettelmeyer criterion seems reasonable, and we will adopt it in assessing whether the federal government's fiscal policies are consistent with a declining debt ratio.

Our SDSA model is based on the standard public sector debt dynamics identity:

$$b_{t+1} = \frac{(1 + v_t) \times b_t - pb_t}{(1 + i) \times (1 + g_t)} \tag{2}$$

5. We shall use the terms "stochastic debt sustainability analysis" and "Monte Carlo simulation model" interchangeably

where b_t is the government's debt to GDP ratio, v_t is the average or effective rate of interest on government debt, pb_t is the ratio of the government's primary budget balance to GDP, i is the annual rate of inflation (assumed to be constant), and g_t is the real GDP growth rate in year t. The denominator in the above equation is one plus the nominal GDP growth rate.

As noted above, primary budget balances decline when the economy is subject to a negative shock. Based on the regression model in Appendix 2 (p. 19), a one percentage-point decline in the growth rate results in a 0.545 percentage-point reduction in the federal primary budget balance ratio. We also model the evolution of the government's primary balance with a partial adjustment model such that the primary budget balance would gradually return to its initial level after a positive or negative growth-rate shock, in the absence of further shocks. Accordingly, we model the evolution of the primary budget balance as:

$$pb_t = (1 - \varphi) \times pb_0 + \varphi \times pb_{t-1} + \delta \times z_t \tag{3}$$

where z_t is the growth rate shock in year t, pb_0 is the initial or target primary budget balanced, $\delta = 0.545$, and $\varphi = 0.964$ based on the regression results in **table A2.** The growth rate shock, z_t, is the sum of an annual random shock with a normal distribution with mean zero and standard deviation of 1.32%, and a recession shock of −6.13 occurs with an 8.5% probability each year. See **Appendix 1** for details concerning the modelling of the economic shocks.

The effective interest rate on government debt changes over time as the existing debt is refinanced at the current nominal interest rate. We model the evolution of the effective average interest rate on government debt as a weighted average of the interest rate on existing debt in year t and the interest rate on 10-year Government of Canada bonds where the weights depend on the fraction of the debt that is rolled over in year t. The fraction of the debt to be rolled over each year and the interest rates on existing debt are based on the data in table 6.1 in *Public Accounts 2022* (Canada, Department of Finance, 2022c). The effective interest rate on government debt is therefore equal to:

$$v_t = w_t \times v_t + (1 - w_t) \times v_{t-1} \tag{4}$$

The nominal interest rate on government debt in year t is based on the Fisher equation:

$$v_t = i + r_t + i \times r_t \tag{5}$$

where i is the inflation rate, assumed constant, and r_t the real, or inflation-adjusted, interest rate in year t. The economic literature reviewed by Dahlby, Ferede, and Fuss (2022), indicate that the real interest rate on government debt increases as a government's debt ratio increases. Consistent with the literature, the econometric model in table A3 indicates that a 10 percentage-point increase in the net debt-to-GDP ratio increases the real rate of return on long-term government bonds by 51 basis points. The econometric model also indicates that real interest rates are positively associated with an increase in the growth rate. Accordingly, the real interest rate on government bonds is determined by the following equation:

$$r_t = \rho + \alpha \times b_t + \beta \times g_t \tag{6}$$

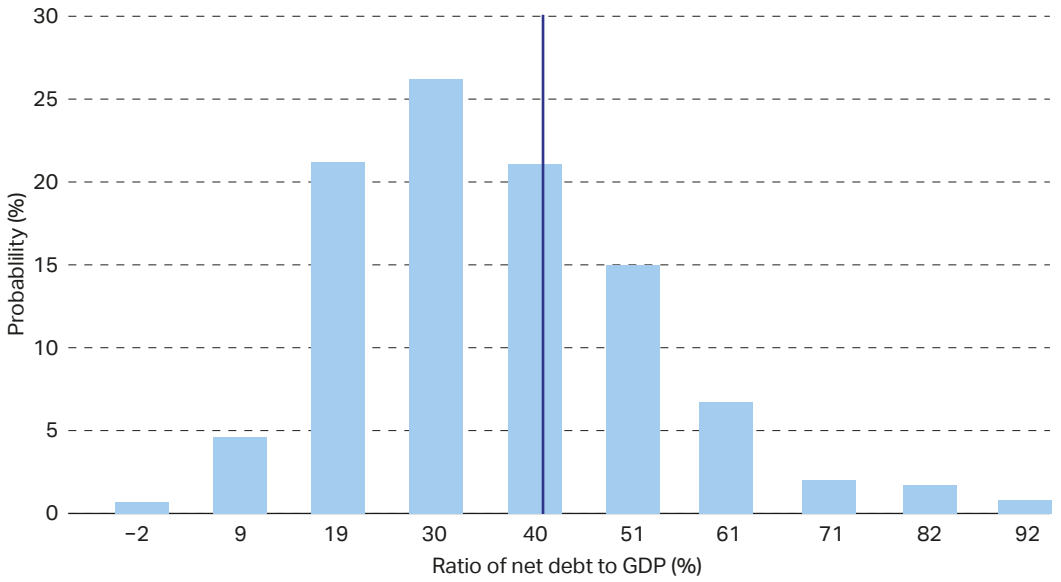
where $\alpha = 0.051$, $\beta = 0.367$, and ρ is a constant such that the real interest rate is initially 1.0% in the simulation model as assumed in the federal debt-ratio projections in the 2022 *Fall Economic Statement*. Also, consistent with the federal debt-ratio projections, we assume an annual real GDP growth rate of 1.6% in the absence of a growth rate shock and a 2% annual inflation rate.

The starting point for the simulations is based on the projected fiscal variables for 2026/27 in the *Fall Economic Statement*, with a net debt-to-GDP ratio of 42.75%, a primary budget surplus of 1.41% of GDP, and an effective interest rate on federal debt of 3.0%. In other words, the starting point for our simulations assumes that the federal forecasts of the economic and fiscal variables to 2026/27 are accurate.

We use a Mathcad® program to calculate the evolution of the federal net debt ratio over a 20-year time horizon when the economy is subject to annual growth-rate shocks. We record the net debt ratio after 10 years (2036/37) and 20 years (2046/47). This procedure was repeated 1,000 times to generate the probability distribution of the federal net debt ratio in 2036/37 shown in **figure 4.** The width of each bin is 10.4 percentage points.[6] The solid vertical line represents the debt ratio in 2026/27. The figure shows that the distribution of debt ratios is skewed to the right and there is a 30% chance that the net debt ratio will be higher in 2036/37 than in 2026/27. The model also indicates that there is a 53.3% chance that it will be higher in 2046/47. In other words, the federal government's claim that its fiscal policies will lead to a downward trend in its debt ratio is not plausible because it ignores the likelihood that future recessions will result in larger primary deficits.

6. The size of each bin is the range of debt ratios in the 1,000 episodes divided by the number of bins, 10.

Figure 4: The probability distribution of the federal net debt ratio, 2036/37



Notes: The approximate mid-points of the bins are shown on the horiztonal axis. The vertical line is at 42.75%.

Source: output from the Monte Carlo model.

Before discussing the implications of our analysis for federal fiscal policy, we will probe a little deeper into why there is a high probability that the federal debt ratio could increase in the future. Clearly, our simulations indicate that there is a high probability of an increasing debt ratio in the future because our model incorporates the impact of recessions on federal finances. The federal government's forecast of a declining debt ratio in the 2022 *Fall Economic Statement* assumes steady economic growth. No account is taken of annual economic fluctuations or the possibility of recessions. It is therefore worthwhile examining in more detail the impact of recessions on the federal debt ratio. In our simulations, the average number of recessions over a 20-year period is 1.76, that is, less than one recession every 10 years on average. As shown in **table 2**, in our simulations the likelihood of no recessions occurring over a 20-year time horizon is only 15.1%. The average debt ratio after 20 years in the simulations in which no recessions occurred was 9.7, which is very close to the federal government's projection of its debt ratio.[7] Thus, our model, in the absence of recession, is consistent with the projected federal fiscal policies in the *Fall Economic Statement*. In our simulations, the probabilities of one, two, and three or more recessions over a 20-year time period are 32.2%, 27.6%, and 25.1%, respectively. Note that in the episodes where two recessions occur over a 20-year time horizon, the expected debt ratio after 20 years is 58.8%. Furthermore, if two recessions occur, there is a 60.1% chance that the debt ratio exceeds the initial or benchmark debt ratio of 42.75%.

7. See chart A1.4 in the *Fall Economic Statement* (Canada, Department of Finance, 2022a).

Table 2: The likelihood of recessions and expected debt ratios

Number of recessions over a 20-year time horizon	Probability (%)	Expected debt ratio after 20 years (%)
0	15.1	9.7
1	32.2	34.8
2	27.6	58.8
3 or more	25.1	102.2

Source: authors' calculations.

To lower the probability of an increase in the debt ratio by 10 to 20 percentage points means that the federal government would have to run larger primary surpluses than we have assumed in the simulations described above. To determine the effect of higher primary surpluses on the probability of an increasing debt ratio in the future, we have simulated the model assuming that the federal government runs a primary surplus of 2.0% of GDP, in the absence of economic shocks, rather than the 1.41% assumed in our base case With this more restrictive fiscal policy, the likelihood of a higher debt ratio after 10 years would drop to 21.4%, close to the "plausibility criterion" for a declining debt ratio. Roughly speaking, this implies that a one percentage-point increase in the ratio of the primary surplus to GDP, which is about $28 billion, reduces the probability of an increase in the debt ratio after 10 years by about 15 percentage points.

5. Summary and Policy Implications

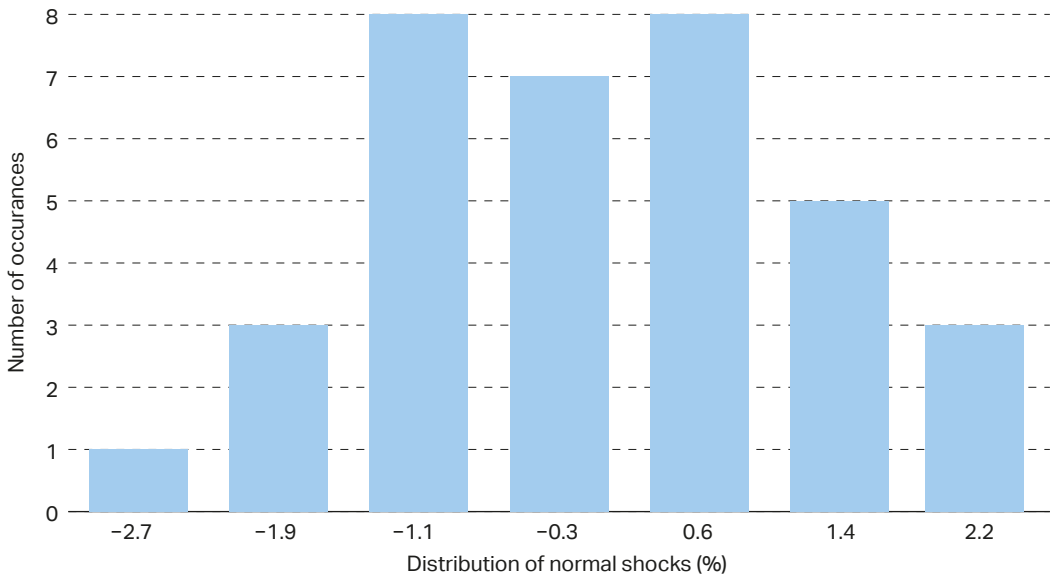
The federal government has adopted fiscal policies that it claims will lower its debt-to-GDP ratio over the medium to long term, but the projected declines in the federal debt ratios assume a steady annual economic growth rate of 1.6% and do not consider the impacts of major economic downturns in the future. We have developed a simulation model that indicates how the federal government's debt ratio could evolve if the Canadian economy is subject to random growth shocks similar to those experienced over the last 40 years. The model indicates that there is a 30% probability that the federal debt will be higher in 2037 than in 2027 and a 53% chance that it will be higher in 2047 than in 2027. Thus, taking the federal government's projected primary surpluses at face value, but with random shocks to the growth rate using what many would regard as optimistic assumptions about the likelihood of future recessions, we find that there is a high probability that the federal debt ratio will increase and the federal fiscal anchor will be violated.

The model highlights the importance of taking the likelihood of recessions into account in setting fiscal policies that are consistent with this fiscal anchor. Clearly, fiscal policies should not try to eliminate the possibility of an increase in the debt ratio when the economy is subject to a negative shock. Nonetheless, we feel that the federal government should adopt more prudent fiscal policy to reduce the likelihood that the federal debt ratio will increase in the future. As demonstrated by Dahlby, Ferede, and Fuss (2022) in a recent Fraser Institute publication, the best way to lower budget deficits and stabilize public debt is through restraining public-sector expenditures.

Appendix 1. Modelling Growth Rate Shocks

We separate fluctuations in the annual growth rate into "recession shocks" and "normal shocks" that occur in non-recession years. We define the normal growth-rate shocks as the deviation in the annual growth rate from the average annual growth rate in three inter-recession periods—1983 to 1990, 1992 to 2008, and 2010 to 2019. The average annual growth rate was 3.29% in 1983–1990, 2.91% in 1992–2008, and 2.26% in 2010–2019. The decline in the average growth rate since 1982 is why we use these average growth rates in the inter-recession periods to calculate shocks rather than the overall average growth rate over the entire 1982–2020 period. Based on this procedure, the normal shocks have a zero mean with standard deviation of 1.825% in 1983–1990, 1.33% in 1992–2008, and 0.90% in 2010–2019. For all inter-recession years, the mean shock is zero with a standard deviation of 1.32%. **Figure A1.1** shows the distribution of the normal shocks. In our Monte Carlo model, we approximate the normal shocks as a normal distribution with mean zero and a standard deviation of 1.32%.

Figure A1.1: Histogram for normal shocks

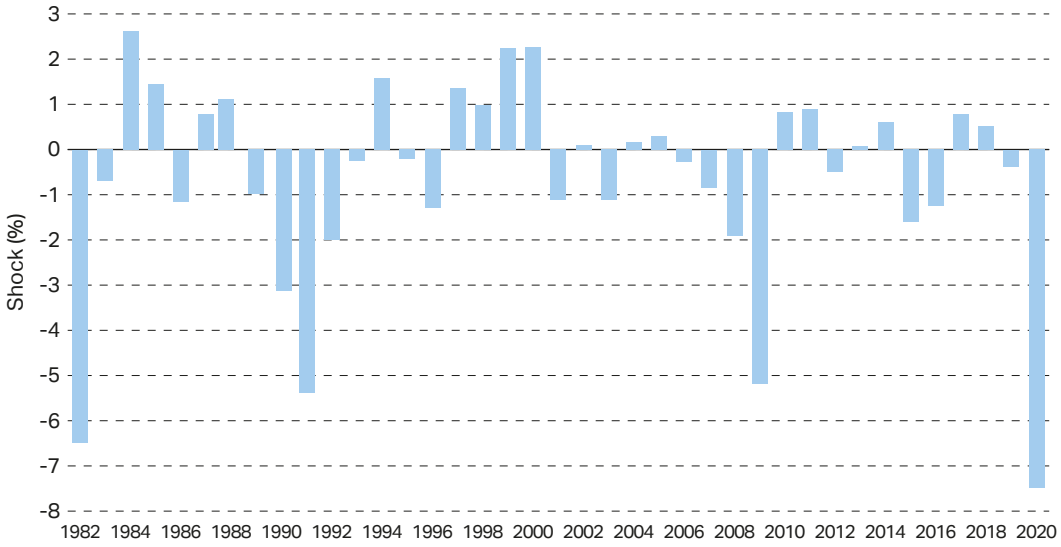


Notes: The approximate mid-points of the bins are shown on the horiztonal axis. the size of each bin in 0.8%.

Source: calculations by the authors based on Statistics Canada, table 36-10-0222-01 (2023).

The recession shocks were calculated as the difference between the (negative) growth rate in the recession year and the average annual growth rate in the recent non-recession years. Thus, the recession shock is −6.84% in 1982, −5.38% in 1991, −5.18% in 2009, and −7.49% in 2020. The average recession shock is −6.13%. **Figure A1.2** shows the normal and recession shocks from 1982 to 2020.

Figure A1.2: Shocks to the GDP growth rate (%), 1982–2020



Source: calculations by the authors based on Statistics Canada, table 36-10-0222-01 (2023).

Appendix 2. Econometric Models of the Fiscal Impacts of Economic Shocks and the Impact of Public Debt on Interest Rates and Growth Rates

In this appendix, we provide an empirical estimation of the relation between economic growth shock and primary balance and the impacts of the public debt of Canada's federal government on the interest rate. We then use the relevant coefficient estimates in our simulation exercise. The basic summary statistics of the key variables of interest are shown in **table A2.1.** The data source for the Canadian long-term real interest rate, the US long-term real interest rate, and the Canadian federal primary balance-to-GDP ratio is the Federal Reserve Bank of St. Louis (2023). The federal net debt-to-GDP ratio data and economic growth rate come from *Finances of the Nation* (2023). Similarly, we obtain the short-term interest rate from Statistics Canada (2023a), table 10-10-0122-01 and population data from Statistics Canada (2022), table 17-10-0005-01.

Table A2.1: Summary statistics of key variables, 1980–2020

Variable	Mean	Std.Dev	Min	Max
Primary balance-to-GDP ratio	0.012	0.028	−0.098	0.059
Economic growth shock	−0.006	0.023	−0.075	0.026
Federal party dummy (Liberal = 1)	0.548	0.504	0.000	1.000
Population share of seniors	0.130	0.025	0.094	0.185
Canada's long-term real interest rate	0.031	0.025	−0.020	0.084
Federal net debt-to-GDP ratio	0.429	0.126	0.225	0.673
US long-term real interest rate	0.026	0.025	−0.033	0.081
Canada's short-term real interest rate	0.020	0.027	−0.033	0.080
Economic growth rate	0.021	0.031	−0.056	0.089
US real GDP growth rate	0.026	0.020	−0.028	0.072
Log of federal net debt-to-GDP ratio	−0.889	0.292	−1.493	−0.396
Growth rate of federal net debt-to-GDP ratio	0.012	0.074	−0.115	0.174

Source: Authors' computations.

The impact of economic growth on the primary budget balance

We begin by providing an empirical estimation of the effect of the economic growth shock and other relevant variables on Canada's federal government primary budget balance. Following the empirical strategy of previous studies such as Zeng (2014) and Maltritz and Wüste (2015), we estimate the Canadian federal government's primary balance-to-GDP ratio on its first lag, economic growth shock, and other relevant explanatory variables. Thus, in our empirical analysis, the primary balance-to-GDP ratio is the dependent variable. The inclusion of the lagged dependent variable as part of the explanatory variables is justified since it captures the commonly observed persistence in the primary balance and allows for slow adjustment in the budget balance.

The economic growth shock is the critical variable of interest in the empirical model. As explained in the paper's main text, we compute economic growth shocks as the deviation in the annual growth rate from the average annual growth rate in three inter-recession periods—1983 to 1990, 1992 to 2008, and 2010 to 2019. As primary budget balance is the net result of governments' revenue and program spending decisions, the economic growth shock is expected to influence the primary balance in many ways. An increase in economic growth and the associated boost in economic activities expand tax bases and ultimately raise the government's revenue and the primary balance. Thus, we expect the economic growth shock to correlate positively with the primary balance-to-GDP ratio.

Our analysis uses annual time series data for Canada from 1980 to 2020. In time series, data-based studies such as ours, it is crucial to check first the time series properties of the various variables and employ an appropriate empirical methodology to obtain reliable coefficient estimates. Consequently, as is common in the literature, we conduct unit root tests and find that all the relevant variables are stationary. Thus, the usual Ordinary Least Square (OLS) estimation method is appropriate in our case.[1] We report our primary balance regression results for the federal government in **table A2.2**.

We begin our analysis in column (1) by estimating the primary balance-to-GDP ratio on its first lag and economic growth shock. The results indicate that, as expected, the primary balance has a statistically significant positive relationship with its one-period lagged value, suggesting the persistence in the primary budget balance. More importantly, we find that the coefficient of the economic growth shock is positive and

1. The Unit root test results are available from the authors upon request.

Table A2.2: Primary balance and growth shocks, 1980–2020

	(1)	(2)	(3)	(4)
Economic growth shock	0.548**	0.585*	0.594**	0.545**
	(0.265)	(0.329)	(0.278)	(0.224)
Lagged primary balance to GDP ratio	0.931***	0.928***	0.972***	0.964***
	(0.071)	(0.081)	(0.132)	(0.095)
Lagged economic growth shock		0.029	0.072	
		(0.100)	(0.072)	
Party dummy			−0.015***	−0.013***
			(0.005)	(0.004)
Population shares of seniors			−4.026**	−4.241**
			(1.822)	(1.768)
Constant	0.002	0.002	0.017***	0.017***
	(0.002)	(0.002)	(0.004)	(0.005)
Observations	39	38	38	39
Adjusted R-squared	0.706	0.698	0.755	0.754

Notes: Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels. Heteroskedasticity and auto-correlation robust standard errors in parenthesis. The dependent variable is the federal government's primary balance-to-GDP ratio.
Source: author's computations based on sources described in text (p.19)..

statistically significant, which is consistent with our prior expectations. An increase in economic growth increases the various tax bases and the associated tax revenue for the government. Similarly, on the spending side of the government budget, higher economic growth can help reduce the various expenditures on social assistance programs. The net result of these two effects is that an increase in economic growth improves the primary budget balance. This estimate is very close to baseline results obtained by Zeng (2014) using data from a cross-section of countries.

In column (2), we include one period-lagged economic growth shock as an additional control variable to capture the possible lagged effects of economic growth shock on the primary balance. However, this variable is statistically insignificant in this and subsequent regressions.

Several previous studies, such as Roubini and Sachs (1989), Tujula and Wolswijk (2007), and Maltritz and Wüste (2015), indicate that political variables tend to influence budget balance. Several previous studies such as Fuss and Globerman (2020) and Tombe (2020) also show that the rise in the population share of seniors puts a lot of fiscal pressure on governments and have an impact on the budget balance. Thus, in column (3), we include the governing party dummy and the population share of people 65 years and above as additional explanatory variables. The party dummy is equal to one if the prime minister belongs to the Liberal party and zero otherwise. If left-leaning governments tend to spend more and run budget deficits, as some studies suggest, we expect the party dummy to have an adverse effect on the primary balance. Similarly, as a result of the various public spending requirements associated with an aging population, we expect the population share of seniors to have a negative relationship with budget balance. As expected, both variables have a negative and statistically significant impact on the primary budget balance. The other variables, except lagged economic growth shock, are also statistically significant.

As the coefficient of the lagged economic growth shock is statistically insignificant and does not improve the model's explanatory power, we drop this variable and re-estimate the model. The results are reported in column (4). As column (4) includes all the relevant variables and the model appears to have more explanatory power, as measured by the adjusted R-squared, we use coefficient estimates of this model in our simulation exercise. The coefficient of our key variable of interest continues to be positive and statistically significant. According to the coefficient estimates, a one percentage-point increase in the economic growth shock is associated with a rise in the primary balance of 0.55% of GDP. Note also that the lagged primary balance is positive and significant, confirming the prevalence of persistence in primary budget balance adjustments.

The impact of public debt on the interest rate

We now turn our attention to estimating the relationship between public debt and the interest rate empirically. More specifically, following the empirical approach of previous studies such as Engen and Hubbard (2004), Laubach (2009), and Claeys, Moreno, and Suriñach (2012), among others, we estimate the Canadian real long-run interest rate on the federal government's net debt-to-GDP ratio and other relevant variables. See Dahlby, Ferede, and Fuss (2022) for a survey of the relevant literature. We use the real long-term interest rate for the federal government in our analysis, as bond yields usually vary across the various levels of government. Note also that we use net debt rather than gross debt as the key variable of interest. See Engen and Hubbard (2004) and Laubach (2009) for the theoretical foundation of our empirical model.

As indicated before, time-series analysis such as ours requires first checking the time series properties of the variables of interest and investigating whether there is a long-term relationship between variables using various cointegration tests. In this regard, our analysis, available from the authors upon request, shows that the interest rate and the debt-to-GDP ratio are non-stationary in levels, but stationary in first differences. The non-stationarity of the variables implies that we cannot simply rely on OLS to obtain coefficient estimates. Previous studies employed various estimation methodologies to investigate long-term relationships between non-stationary economic variables using time-series data such as ours. One method widely used to estimate long-term relationships is the Dynamic Ordinary Least Square (DOLS) estimation method suggested by Stock and Watson (1993). The DOLS empirical approach simply involves including the lagged, contemporaneous, and leads of the first differences of the non-stationary explanatory variables in the model and estimating the equation by OLS. Stock and Watson (1993) indicate that such an estimation of a cointegrated relationship provides super-consistent coefficient estimates and valid statistical inferences are possible if one uses heteroskedasticity and autocorrelation robust standard errors. Thus, we use DOLS as our estimation method. We report our empirical estimates of the effects of the public debt ratio on the interest rate in **table A2.3.**

We begin our analysis in column (1) by estimating the real long-term interest rate on the Canadian federal government's net debt-to-GDP ratio. Column (1) shows that, as expected, the debt-to-GDP ratio has a positive and statistically significant impact on the interest rate. The result shows that an increase in the federal government's net debt, equivalent to 1% of GDP is associated with an increase in the long-term real interest rate by about 15 basis points.

Canada is a small open economy and, as a result, global economic and financial factors can affect the interest rate. In column (2), we proxy for the world interest rate by using the US long-term real interest rate as an additional explanatory variable in the model. The US real interest rate coefficient is positive and statistically significant, confirming the influence of global events on Canada's interest rate. More importantly, the coefficient of the net debt-to-GDP ratio continues to be statistically significant.

In column (3), following Claeys, Moreno, and Suriñach (2012), we include the short-term real interest rate as an additional control variable. We use the Canadian 3-month Treasury bill yield as a proxy for the short-term rate. According to the expectations theory, the long-term interest rate depends on the short-term rate positively. Results of column (3) show that the inclusion of this variable improved the explanatory power of

Table A2.3: Real Interest rate and public debt (Dynamic OLS), 1980–2020

	(1) DOLS	(2) DOLS	(3) DOLS	(4) DOLS
Net debt to GDP ratio	0.148***	0.091***	0.059*	0.051***
	(0.040)	(0.014)	(0.032)	(0.014)
US real interest rate		0.828***	0.569***	0.235***
		(0.119)	(0.149)	(0.061)
Short-term real interest rate			0.310	0.530***
			(0.238)	(0.088)
Economic growth rate				0.367***
				(0.039)
Constant	–0.033	–0.031***	–0.016	–0.016***
	(0.021)	(0.006)	(0.013)	(0.006)
Observations	37	37	37	37
Adjusted R-squared	0.610	0.882	0.919	0.969

Notes: Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels. Heteroskedasticity and autocorrelation robust standard errors in parenthesis. The dependent variable is the Canadian real long-term interest rate. In each regression, the models are augmented with two-period lagged, present, and one-period lead values of the first difference of the non-stationary explanatory variables as suggested by the DOLS method.
Source: Authors' computations.

the model, as suggested by the increase in the adjusted R-squared value. As expected, the short-term real interest rate coefficient is positive but statistically insignificant. Further, the net public debt ratio coefficient is still positive and statistically significant, although the magnitude of the estimate is slightly lower.

In column (4), as in Engen and Hubbard (2004) and Claeys, Moreno, and Suriñach (2012), we include the real GDP growth rate as an additional explanatory variable and re-estimate the model. As this model has all the relative variables and fits the data better, as shown by the high adjusted R-squared value, this is our main result, and we use the coefficient estimates in the simulation exercise. Consistent with our expectations and the findings of previous studies, the coefficient of economic growth rate is positive and statistically significant. One reason for this could be that the central bank may follow a tighter monetary policy when the economy grows and inflation pressure mounts. Note also that the coefficient of

the net debt ratio is still positive and statistically significant. According to our estimate, a ten percentage-point increase in the federal government's net debt-to-GDP ratio is associated with an increase in the real long-term interest rate by about 51 basis points.

The impact of public debt on economic growth

We also investigate how the federal public debt affects the country's economic growth rate. To this end, we follow the methodology of similar earlier studies such as Spilioti and Vamvoukas (2015), Gomez-Puig and Sosvilla-Rivero (2017), and others. We measure the economic growth rate by the first difference of the log of per-capita real GDP. This variable is stationary. The federal net debt-to-GDP ratio, on the other hand, is non-stationary in levels. Thus, to make the model statistically suitable for regression, the explanatory variables need also to be stationary to avoid the problem of spurious regression. Thus, the model is specified as follows:

$$Growth\ rate = \Delta ln(y_t) = \beta_0 + \beta_1 \Delta ln(b_t) + X_t' \theta + u_t$$

where Δ denotes change, ln refers to logarithm, y_t is the real per-capita GDP in year t, b_t is the federal net debt-to-GDP ratio, X captures a vector of other explanatory variables, and u_t is the error term. In the above specification, our coefficient of interest is β_1 and it measures the effect of the federal net debt-to-GDP ratio on the real per-capita GDP growth rate. Note that ideally we would like to estimate the economic growth rate on the net debt-to-GDP ratio rather than on change in the debt-to-GDP ratio. However, this is not feasible since the debt-to-GDP ratio is non-stationary.

As in common in the growth literature, we include the population growth rate, the inflation rate, the US GDP growth rate, and openness (measured by sum of export and import as a ratio of GDP) as additional control variables. To capture the potential persistence in the growth rate, we also include the one-period lagged value of the economic growth rate among the controls. We report the regression results in **table A2.4.** Although we show the coefficient estimates of all the explanatory variables, for brevity we focus our discussion on the federal net debt-to-GDP, which is our key variable of interest.

In column (1), we begin by estimating the economic growth rate on its own lag, the federal net debt-to-GDP ratio, openness, population growth rate, and the US growth rate. We estimate the model using Ordinary Least Square (OLS). The results reported in column (1) show that there is a statistically significant negative relationship between

Table A2.4: Economic growth and public debt, 1981–2020

	(1) OLS	(2) 2SLS	(3) 2SLS
Δln (net debt-to-GDP ratio)	–0.132***	–0.084***	–0.074***
	(0.032)	(0.016)	(0.023)
Δln (Openness)	0.110***	0.114*	0.073
	(0.040)	(0.061)	(0.062)
Population growth rate	–0.966	–1.184	–0.942
	(1.012)	(0.899)	(0.845)
US growth rate	1.094***	1.104***	1.123***
	(0.092)	(0.058)	(0.060)
Lagged growth rate	0.040	0.073	0.081
	(0.080)	(0.077)	(0.079)
Inflation rate			–0.122*
			(0.063)
Constant	–0.008	–0.006	–0.007
	(0.009)	(0.009)	(0.009)
Over-identification test (p-value)		0.756	0.480
Observations	39	39	39
Adjusted R-squared	0.750	0.736	0.725

Notes: Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels. Heteroskedasticity and autocorrelation robust standard errors in parenthesis. The dependent variable is economic growth rate as measured by the first difference of the log of real per-capita GDP. In columns (2) and (3), the federal net debt-to-GDP ratio is instrumented with its own one-period lagged value and lagged federal election dummy.
Source: Authors' computations.

the public debt and economic growth rate. According to the empirical estimate, a 10% increase in the federal net debt-to-GDP ratio is associated with a reduction in the country's real per-capita GDP by about 1.3%.

The analysis in column (1) assumes that the federal net debt-to-GDP ratio is exogenous. However, this may be an unrealistic assumption. When the economic growth rate

decreases, the government may collect less tax revenue as a result of a reduction in the tax bases associated with the decline in the overall economic activities. The government may also need to raise its spending on employment insurance and other services during economic downturns. These will require the government to run budget deficits and accumulate public debt. Thus, the federal net debt-to-GDP ratio may be endogenous. To circumvent this problem, we use the two-stage least square (2SLS) instrumental variable estimation method in column (2). We use the one-period lagged value of the federal net debt-to-GDP ratio and the one-period lagged federal election dummy variable as instruments. The federal election dummy is equal to one in the year in which there is a federal election and zero otherwise. The various statistical tests show that these instruments are valid. The results reported in column (2) show that there is still a statistically significant negative effect of public debt on the economic growth rate. The magnitude of the coefficient estimate, however, is now lower in absolute value, suggesting that the impact of the public debt on growth rate will biased upwards if the problem of endogeneity is not addressed.

Finally in column (3), we include the inflation rate to capture the effects of monetary policy on economic growth as is common in previous studies. This is our main model as it includes all the relevant explanatory variables. The result shows that a 10% increase in the federal net debt-to-GDP ratio causes a 0.74% decrease in the country's real per-capita GDP. Note also that the negative relationship between net debt and economic growth is also robust to various sensitivity checks.

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About the Authors

Bev Dahlby

Bev Dahlby, Senior Fellow of the Fraser Institute, attended St. Peter's College, the University of Saskatchewan, Queen's University, and the London School of Economics. He was Professor of Economics at the University of Alberta from 1978 to 2012 and Distinguished Fellow in Tax and Economic Growth at the School of Public Policy at the University of Calgary from 2012 to 2020. Prof. Dahlby has published extensively on tax policy and fiscal federalism. He has served as an Associate Editor of *Canadian Public Policy* and a member of the editorial board of the *Canadian Tax Journal*. He has been a member of the Executive Council of the Canadian Economics Association and the National Statistics Council. Prof. Dahlby has also served as a policy advisor to the federal and provincial governments. In 2010/11, he was a member of the Expert Panel on Federal Support to Research and Development (Jenkins Panel) and the Ecofiscal Commission from 2014 to 2019. In July 2016, he was appointed Chair of the British Columbia Commission on Tax Competitiveness by the BC Minister of Finance. In May 2019, he was appointed by the Government of Alberta to the Blue Ribbon Panel to review the province's finances. His international experience includes advisory work on tax reform for the IMF in Malawi, for the Thailand Development Research Institute, and for the World Bank in Brazil and Mexico.

Ergete Ferede

Ergete Ferede is Professor of Economics at MacEwan University in Edmonton, where he has held an academic appointment since 2006. He received his Ph.D. in economics from the University of Alberta. He has previously taught at Addis Ababa University (Ethiopia), University of Alberta, and University of Windsor. Prof. Ferede has been actively engaged in research on taxation policy and intergovernmental grants. He also conducts research on the efficiency costs of taxes, the effects of taxes on various economic activities, corporate income-tax policy, and tax reform. His research has been published in the *National Tax Journal*, *International Tax and Public Finance*, *Small Business Economics*, and *Public Finance Review*.

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