The Impact of Higher Interest Rates on the Cost of Servicing Government Debt

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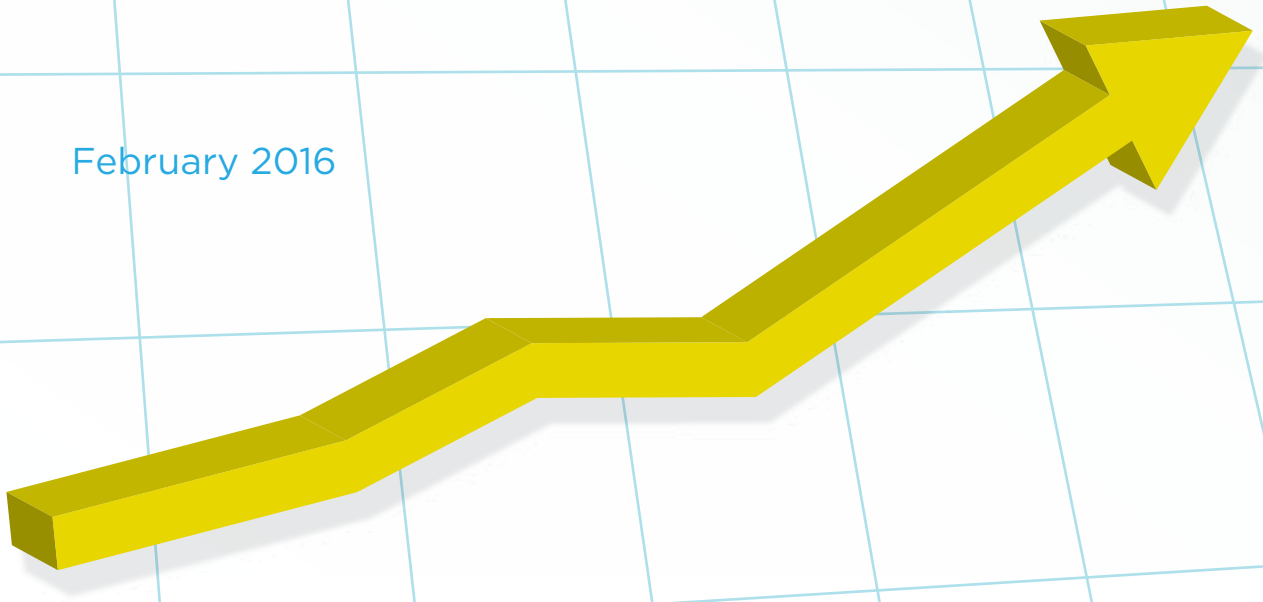

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Summary

An important fact to consider when assessing the medium-term fiscal plans announced by the federal and provincial governments is that interest rates are at historically low levels. A return to more normal levels would jeopardize promises for balanced budgets or surpluses and increase the proportion of revenues spent on debt interest payments (the "interest bite"). More revenue going to interest payments on the debt means less is available for programs that taxpayers value, such as health care and education, or tax relief.

This study analyzes the budgetary implications of interest rate risks faced by governments, using as examples the short- and medium-term budget plans (2016–17 to 2019–20) of Ontario and Quebec, Canada's two largest provinces and the most indebted as a share of GDP. The study also provides a background discussion about interest rates and provincial debt maturity structures.

Two scenarios are considered where interest rates rise faster and/or higher than forecasted in Ontario's 2015 budget. In Scenario 1, rates rise to 3.5 percent in 2016–17 and to 4.5 percent from 2017–18 to 2019–20. This compares to rates in the baseline case of 2.7 percent in 2016–17, 3.8 percent in 2017–18, 4.2 percent in 2018–19, and 4.5 percent in 2019–20. In Scenario 2, rates rise to 4.5 percent in 2016–17 and attain 5.0 percent from 2017–18 to 2019–20. (Quebec states its interest rate forecast only for 2016–17, but it projects its spending and revenues until 2019–20. The analysis assumes Quebec's budget is based on the same interest rates as Ontario after 2016–17. While Ontario provides its medium-term interest rate forecast, it projects spending and revenues only to 2017–18. Hence, the analysis extends Ontario's budget projections to 2019–20 by assuming that program spending and revenues will grow at the same rate as the economy.)

The interest rate shocks described by Scenario 1 would increase Ontario's projected deficit by $264 million in 2016–17 and derail the government's expectation of achieving budgetary balance in 2017–18. In Scenario 2, Ontario's deficit increases by $616 million in 2016–17 and the expected budget balance in 2017–18 is replaced by a deficit of $857 million. In 2019–20, Ontario's cost of interest rises by $498 million in Scenario 1 and to almost $1.2 billion in Scenario 2. Ontario's interest bite would rise from its current value of 9.2 percent of revenues in 2015–16 to 10.1 or 10.4 percent in 2017–18 under Scenarios 1 and 2, respectively.

The Quebec government is projecting budget surpluses every year from 2016–17 to 2019–20. The effect of the interest rate shocks is to substantially reduce, though not reverse, the projected surpluses. Under Scenario 1, the surplus falls by

$363 million in 2016–17 and by $440 million in 2019–20. In Scenario 2, Quebec's projected surplus declines by $524 million in 2016–17 and by nearly $1 billion in 2019–20. Quebec's interest bite would rise from its current value of 10.5 percent in 2015–16 to 10.8 or 11.3 percent in 2017–18 under Scenarios 1 and 2, respectively. Thus, even relatively modest increases in interest rates would have important adverse effects on the short- and medium-term budgets of Ontario and Quebec, and would oblige the provinces to devote a larger share of revenues to financing interest payments on debt.

Provincial governments have been shifting the structure of their debts toward longer terms to maturity. In this way, they are able to postpone the need to refinance their debts at higher interest rates, if rates were to rise. However, in the long run all of the government's debt eventually matures. The final part of the study explores the budgetary implications of interest rates on provincial debt rising to 5 percent permanently (with 2 percent price inflation), starting in 2016–17. The primary surplus (revenues minus non-interest spending) would have to be increased each year (forever) by about $3.5 billion in Ontario and by $2.1 billion in Quebec. Otherwise, provincial debt as a share of the economy would rise above the 2016–17 level in each province.

The analysis indicates that a faster-than-expected rise in interest rates toward normal levels could upset Ontario's already delicate path toward fiscal sustainability. In Quebec, the danger is mitigated to some extent by the government's commitment to fiscal reforms, announced in its latest budget, to achieve annual surpluses through spending restraint. Should the government waver on its commitment, then the interest rate risk would exacerbate the province's already very high debt-to-GDP ratio. The bottom line is that governments should not be sanguine about the current low interest rates when forming their upcoming budgets.

1 Introduction

Since the recession in 2008–09, the federal government and most provincial governments have racked up public debt to finance the gaps between their spending and revenues. Total (consolidated) federal-provincial/territorial government net debt in Canada was $1.25 trillion in 2014–15, or 63 percent of the size of the economy, up from 53 percent in 2007–08.[1] More than half of this debt increase has been by the provinces/territories. A consequence of this borrowing spree is that annual government revenues, which might otherwise be available for programs that taxpayers value, such as health care and education, or tax relief, must be diverted to paying interest on the debt. The cost of debt service occupies an important part of government revenues. Canada's two most indebted provinces, Quebec and Ontario, spent 10.8 percent and 9.0 percent of their total revenues, respectively, on interest payments in 2014–15, while the federal figure was 9.6 percent. For comparison, the proportion of revenues allocated to education spending was 20.8 percent in Ontario and 21.8 percent in Quebec.[2]

To begin to address the debt burden, the federal government produced a small surplus in 2014–15 and Ontario plans to eliminate its annual deficit by 2017–18, while Quebec expects to balance its budget starting in 2015–16, with surpluses to follow. An important fact to consider, when assessing the medium-term fiscal plans announced by the federal and provincial governments, is that interest rates are at historically low levels. A return of interest rates to more normal levels would increase the proportion of revenues spent on interest payments, colourfully known as the "interest bite," jeopardizing the promises of governments to achieve balanced budgets. Provincial governments in Canada are the most indebted subnational governments in the OECD.[3] Consequently, interest rate changes would, in principle, have a bigger effect on subnational government finances in Canada than in any other OECD country.

1. See Tables 15 and 31 in the *Fiscal Reference Tables 2015*. This is the latest available year for consolidated debt figures. A loan from one government to another represents both an asset for the lending government and a liability for the other, and they cancel out for the consolidated government sector as a whole.
2. The proportion of revenues spent on interest payments and education are based on the provincial and federal budget documents for 2015.
3. See OECD (2014: Figure 1.8).

Many analysts believe that interest rates will begin to rise in 2015–16 in the United States, which would put upward pressure on Canadian rates.[4] Although the medium-term budget outlooks of the federal and provincial governments do factor in an expected increase in interest rates, the rates are assumed to remain below the historical average. Given large and growing public debt levels in Canada, the fiscal outlooks of the federal and provincial governments are sensitive to the risk that interest rates will go higher than expected. Consider that Ontario's 2010 budget forecasted an interest bite for 2014–15 of 11.7 percent, whereas the actual rate, noted above, came in much lower, largely due to unexpected declines in market interest rates. A reversal of the fall in interest rates clearly would have an adverse effect on the size of interest payments on the public debt. Some governments are more vulnerable than others, particularly highly indebted provinces such as Ontario and Quebec. The credit rating of the Ontario government was lowered by Standard & Poor's in July of 2015. Its rating on long-term bonds is the same as Quebec's and below S&P's ratings of British Columbia, Alberta, Saskatchewan, and Manitoba. Governments have taken measures to reduce their exposure to rising interest rates in the short run by lengthening the average term to maturity of their debts. However, if interest rates were to increase significantly, then the cumulative impact of refinancing maturing debt obligations each year at the higher interest rates would be substantial.[5]

The aim of this paper is to provide a quantitative analysis of the budgetary implications of interest rate risks for governments, using as examples the short- and medium-term budget plans of Ontario and Quebec, Canada's two largest provinces and the most indebted as a share of GDP. No one can predict with confidence when, or even if, interest rates may rise, but the sensitivity analysis provided in the paper can inform readers of the likely impacts of higher interest rates on the finances of indebted provincial governments. Section 2 of the paper provides a general background discussion of interest rates and government debt. Section 3 carries out the quantitative analysis of the medium-term sensitivities of Ontario and Quebec to rising interest rates. Section 4 considers the longer-term impacts of permanently higher interest rates. Concluding comments are in section 5.

4. See, e.g., Spicer (2015).

5. The Bank of Canada can influence short-term interest rates by changing the target interest rate at which major financial institutions borrow and lend one-day (or "overnight") funds among themselves. However, medium- and long-term rates are determined primarily by market demand and supply for funds.

2 Interest Rates and Government Debt

To facilitate an understanding of the interest rate risks to the Ontario and Quebec provincial budgets, it is important to first review some key concepts relating to interest rates and the structure of public debt. This section explains the concepts and provides a historical perspective on interest rates and debt.

Interest Rates and Rollover Risk

Households typically borrow money by obtaining a loan from a bank at a stipulated interest rate. Governments usually borrow by selling financial products, such as bonds and other types of securities, to investors. In exchange for a lump sum of cash—i.e., the price of the security—the government provides the investors with interest payments at regular intervals and a reimbursement of the principal at some fixed future date.[6] The debt of Canadian governments is composed of a portfolio of securities with different maturities. The term to maturity of a bond indicates the number of years before the principal amount must be repaid. **Figure 1** depicts the historical interest rates on Government of Canada marketable bonds at various maturities, going back to 1951.[7] The short-term bonds have maturities of one to three years, the medium-term bonds are five to ten years, and the longer-term bonds mature in more than 10 years.

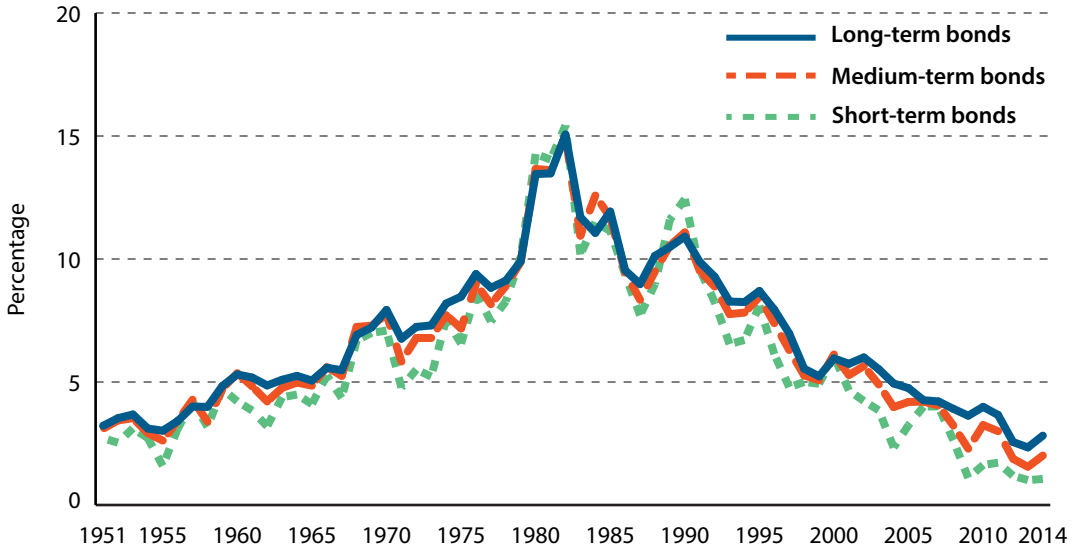
There are several observations to be made from figure 1. Interest rates are lower now than in any of the preceding six decades.[8] Interest rates have been trending downward since the early 1980s, and pushed to new lows in the aftermath of the 2008–09 recession. The medium- and long-term Government of Canada bond rates in 2015 stand at about 2 and 3 percent, respectively. Secondly, the interest rates corresponding to different maturities tend to move together closely, but the shorter maturities typically carry lower interest rates. Longer-term bonds usually require relatively higher interest rates, because investors want compensation for

6. The principal is the face value of the bond. Sometimes the face value of a bond will differ from the price the bond is sold for in the market. A bond's interest payments, together with the reimbursement of principal, are essentially a package of future payments; the price an investor is willing to pay for a given package of future payments will depend on how it compares with alternative investments that are available.

7. Technically, the interest rates in figure 1 are bond yields. Yield refers to the rate of return on a bond, given the price paid for the bond. This paper will not distinguish between yields and interest rates on loans.

8. The profile of "real" interest rates, which adjust the market rates to account for inflation, follow a similar pattern of decline after 1982 and are presented in figure 4 below.

Figure 1: Interest Rates on Government of Canada Bonds



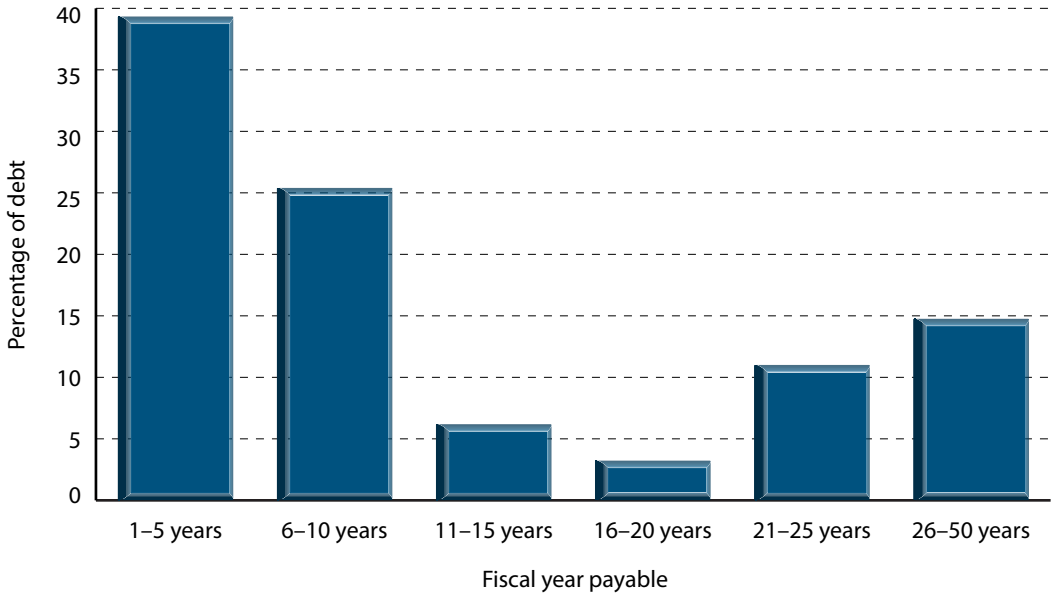
Source: Government of Canada Marketable Bonds, Average Yield, Bank of Canada, Data and Statistics Office.

the risk associated with locking in their principal for a longer period of time. This is particularly the case when the economy is sluggish but expected to improve, since an uptick in economic activity often portends an increase in inflation, which then erodes the value of the principal when it is repaid to the lender. From the perspective of borrowers, the advantage of a low interest rate on short-term securities must be traded off with the risk that the maturing debt will have to be refinanced at a time when interest rates are rising. This is called rollover risk (or refinancing risk). Governments often borrow more money to pay off the principal on a bond that has matured. If this refinancing of the debt occurs at a higher interest rate than the rate paid on the maturing bond, then the "average" interest rate on the government's debt must go up.

In contrast to bonds with short terms to maturity, longer-term bonds may carry a relatively higher interest rate, but they lock in that interest rate for a longer period and thereby postpone the rollover risk. Thus, the decision of governments as to whether to issue short-term versus medium- or long-term bonds depends on their expectations about how interest rates may change in the coming years. Governments in Canada sell bonds with terms to maturity as long as 50 years, as well as securities that mature in less than one year. At any given time, public debt consists of a variety of bonds and other types of securities with different terms to maturity and different interest rates, reflecting both past and present borrowing decisions. Provincial budget documents provide detailed breakdowns of the composition of public debt in terms of when the various debt instruments will mature.

Figure 2 shows the proportion of Ontario debt maturing at various numbers of years from the present. 65 percent of the province's debt matures over the next 1 to 5 years or 6 to 10 years.

Figure 2: Ontario's Debt Maturity Structure



Source: Ontario's 2015 budget.

Provincial Spreads over Federal Bond Rates

The interest rates shown in figure 1 are for the federal government's bonds. The interest rates provincial governments must pay on their own debts are higher than for the federal government, because bonds sold by provincial governments are perceived by investors as being relatively riskier. One reason for the relatively low-risk status of federal bonds is that the federal government has the authority to tax the entire country, while provincial governments are confined to their jurisdictional boundaries. Another reason for the lower risk federally is the possibility of the Bank of Canada purchasing federal government bonds essentially by printing more money to reduce the federal debt and deficit.[9] Kneebone (1994) argues that the downgrades of the credit ratings of provincial governments during the Canadian debt crisis of the 1990s, without corresponding downgrades of the federal government's creditworthiness, reflected the market's belief that the federal government can more easily avoid defaulting on its loans than provincial

9. One way the Bank of Canada could "monetize" part of the federal debt is by purchasing large amounts of Government of Canada bonds and returning the accrued interest to the federal government in the form of the Bank of Canada's profits (Robinson, 1995).

governments, due to the potential for monetizing federal debt. More generally, the difference, or "spread," between the interest rate on a bond of a provincial government, versus the rate on a bond of the federal government, is a measure of the relative risk that investors place on the probability that a provincial government will default on the repayment of its loans. In other words, investors demand a risk premium for holding provincial debt. The interest rate spread relative to the federal government is currently about 1 percentage point in both Ontario and Quebec.[10] The current spreads are higher than the pre-recession spreads.

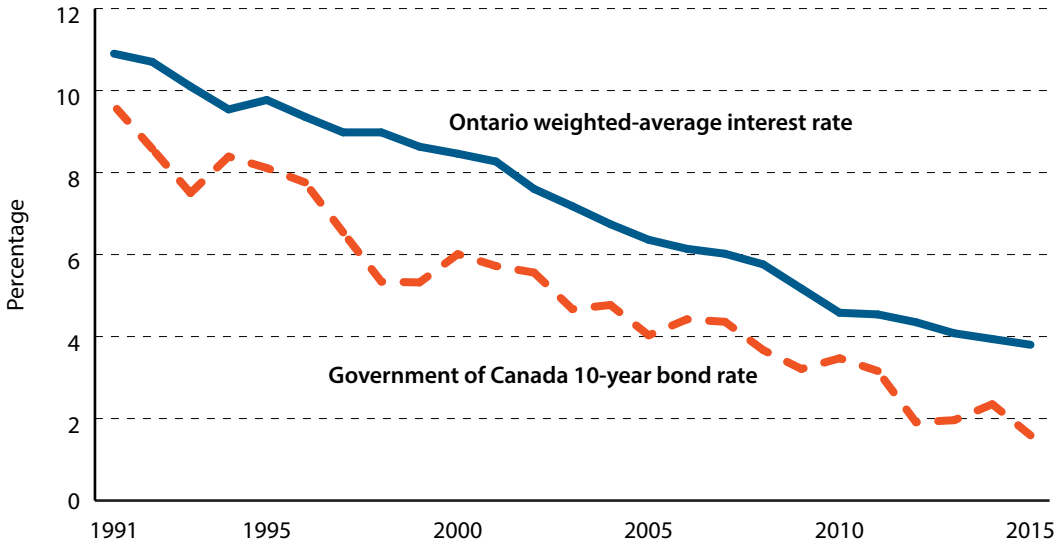
Weighted-Average Interest Rate on Public Debt

The governments of Ontario and Quebec report the weighted-average interest rate on the provincial debt. The weighted-average interest rate takes into account the proportion of the government's debt issued at different terms to maturity and their corresponding interest rates. Thus, the weighted-average interest rate can change from year to year as a result of fluctuations in interest rates, and because of changes in the proportion of the debt that the government chooses to issue at different terms to maturity. In 2014, the weighted-average interest rate on Quebec public debt was 3.91, down from 4.0 the previous year.[11]

Ontario's 2015 budget gives a weighted-average interest rate in Ontario for every year since 1990–91. These rates are plotted in **figure 3**. The rate has fallen steadily since 1990–91 and stands at about 4 percent in 2015. The average term to maturity of Ontario's debt is about 14 years in 2015. Figure 3 also depicts the interest rate on Government of Canada 10-year bonds. The gap between the two curves is the spread between the weighted average Ontario interest rate and Government of Canada 10-year bond rates.[12] As can be seen, the weighted average interest rate on Ontario's public debt is higher than on 10-year Government of Canada bonds, reflecting the greater risk associated with provincial bonds.[13]

10. See Joffe (2012) for estimates of the spread for each province in 2012. Chart E12 in Finances Québec (2015b) gives the spread for Quebec on 10-year bonds from 2004 to 2015. The spread for Quebec has remained close to one percentage point from 2012 to 2015.
11. See *Quebec Public Accounts 2013–2014*, p. 137.
12. Ideally, figure 3 would show the spread between the 10-year bonds of the Ontario and federal governments, but a time series of the provincial rates is not available.
13. The spread between the curves depicted in figure 3 will change over time, not only because the provincial risk premium changes, but also as a result of changes in the maturity structure of the province's debt. In contrast, the analysis of spreads by Joffe (2012) compares the yields on provincial and federal bonds of similar terms to maturity, but only for the year 2012.

Figure 3: Comparison of Ontario Weighted-Average Interest Rate and Government of Canada 10-year Bond Rate



Sources: Ontario's 2015 budget; Federal Reserve Economic Data, Federal Reserve Bank of St. Louis.

The weighted average interest rate is a key figure for estimating how a province's interest payments would change if interest rates were to rise. In particular, only a portion of a province's debt matures in a given year, or is subject to variable interest rates. Consequently, a one percentage point rise in the interest rate, say, next year, would not translate into a one percentage point increase in a province's weighted average interest rate. Indeed, Ontario uses debt management strategies to limit the province's exposure to rising interest rates; currently, about 10.2 percent of Ontario's public debt would bear the higher interest rate in 2015–16. It would take about 10 years for at least 65 percent of the province's debt to be exposed to refinancing at higher interest rates. In other words, if interest rates increase by one percentage point, say, in 2016–17, and remain at that higher level indefinitely, then the weighted average interest rate on the province's debt would be expected to increase by 0.10 percentage points in 2016–17, and continue to adjust upwards gradually, as each year another small slice of the original debt maturities roll over at the higher interest rate.

Similarly, in 2015–16, 87.4 percent of Quebec's total debt is fixed rate debt, defined as "debt that will not mature, and whose rates will not change, over the coming year."[14] This implies that 12.6 percent of Quebec's debt is subject to the risk of an increase in interest rates in 2015–16.

14. See *Quebec Public Accounts 2013–2014*, p. 130.

Real Interest Rates

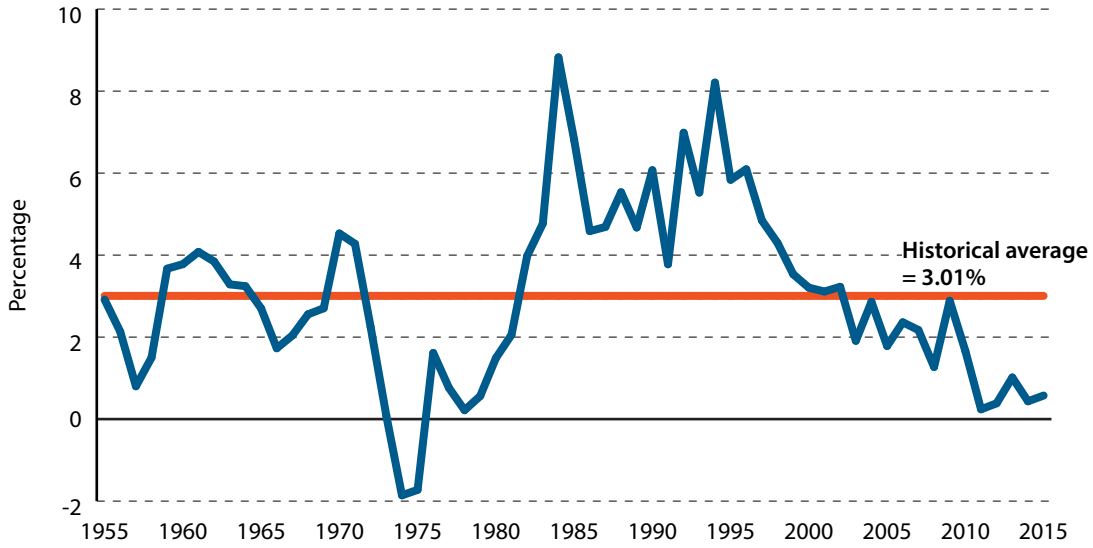
When investors decide on what are acceptable levels of interest rates on government bonds, they take into account the inflation rate that they expect to occur over the time to the maturity of the bond. As a more familiar analogy, think of the interest rate on a bank loan that must be repaid in exactly one year's time. Suppose the inflation rate is expected to be zero over the next 12 months and that the lender (the bank) seeks an annual return of 2 percent. If the loan is $1,000, the lender would be reimbursed the principal of $1,000 in one year's time, plus $20 in interest, for a total of $1,020. The lender's rate of return is then $20/$1,000, or 2 percent. In other words, the rate of return is equivalent to the interest rate on the loan. Now, suppose, instead, that price inflation is expected to be 1 percent over the next year. The lender will still receive $1,020 in exactly one year's time, but the value of that money will be eroded by the fact that prices have increased by one percent in the meantime. That is, the original $1,000 principal can now only buy $990 worth of goods and services due to the price inflation. In effect, the lender receives $1,010 in terms of purchasing power, rather than the "nominal" amount of $1,020. The "real" interest rate is, therefore, the interest rate on the loan (two percent), minus the expected inflation rate (one percent). It is the real interest rate that investors in government bonds care about. Thus, if a real rate of return of 2 percent is required on a loan or on an investment in a government bond, then the lender/investor will only undertake the transaction if the posted interest rate, net of the expected inflation rate, equals the required real rate of return. To put it differently, real interest rates are what ultimately matter for lenders and borrowers.

These observations are pertinent for analyzing the impacts of increases in interest rates. That is, it is necessary to postulate whether any projected increase in interest rates is due to higher expected inflation, or is the result of an increase in the real rate of return. If the increase is purely due to higher inflation expectations, then if interest rates were to rise, so too, presumably, would (nominal) GDP and government revenues. In that case, the interest bite or the debt-GDP ratio would not necessarily change as interest rates rise. In contrast, if the increase in interest rates stems from an increase in the real interest rate, then tax revenues and (nominal) GDP would not increase with the rise in interest rates, since there is no accompanying increase in the rate of price inflation. Hence, only changes in real interest rates have fundamental effects on a government's financial position.[15]

15. In reality, it is often the case that central banks use monetary policy to raise real interest rates, precisely to prevent inflation from rising. The dynamics can be complex, with inflation increasing, followed by restrictive monetary policy by the central bank. A rise in real interest rates can also reduce GDP growth and government revenues, if the rate hike results in a cut in economic activity.

Government budgets explicitly state their assumptions about 10-year Government of Canada bonds and they construct their fiscal outlooks to be consistent with those assumptions. **Figure 4** shows the real interest rate associated with Government of Canada 10-year bond rates from 1955 to the present. The horizontal line indicates the historical average for the whole period. The construction of the real interest rates in figure 4 assumes that the inflation rate that market participants expect at the beginning of each year turns out to be the inflation rate actually observed after the fact. Obviously, the markets could not have always forecasted inflation rates accurately, but the assumption that they did so provides a reasonable proxy for measuring the real interest rate each year.

Figure 4: Real Interest Rates for Government of Canada 10-year Bonds



Sources: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis; Statistics Canada, CANSIM table no. 326-0020.

What we see from figure 4 is that real interest rates have never been lower than currently, except for the mid-1970's, when the OPEC price shocks led to high inflation rates. The real interest rate on 10-year bonds is about 1.67 percent in 2015. In contrast, the historical average real interest rate on 10-year government of Canada bonds over the period 1955 to 2015 is higher, at 3.01 percent. Thus, the "normal" level of the real interest rate on 10-year Government of Canada bonds is about 3 percent.

To convert the real interest rates back into expected market rates, one has to add back expected inflation. Ontario's 2015 budget forecasts that annual inflation will be 2.0 percent throughout the medium term, starting in 2016–17. Thus, a market interest rate on 10-year Government of Canada bonds of about 5 percent

(3.0 real rate + 2.0 inflation) is consistent with the historical average value of the real interest rate. It is noteworthy that Ontario's 2015 budget provides a forecast for the market interest rate of Government of Canada 10-year bonds of 4.2 percent in 2018, while the long-term projection in Ontario Ministry of Finance (2014) is for the market interest rate on 10-year Government of Canada bonds to equal 5.1 percent from 2018 to 2022 and 5.2 percent from 2023 to 2035, with 2 percent annual inflation throughout the period. These expectations for the market interest rates in the longer term are broadly consistent with the historical average real interest rates depicted in figure 4.

Before presenting the quantitative analysis of the sensitivity of provincial budgets to rising interest rates, we should consider whether there are reasonable grounds for considering a return of interest rates from their historical lows to more normal levels over the medium term.

Could Interest Rates Stay Low Indefinitely?

Several analysts have been putting forward arguments for the idea that the low interest rates observed in the markets today will never revert to their historical average. The essence of the so-called "secular stagnation" hypothesis is that low real interest rates reflect a permanent increase in global savings and a permanent decrease in investment demand. Low real interest rates may be a long-run equilibrium outcome of such fundamental changes in the economy. One channel through which this may be occurring is demographics. As the average age of many countries' populations rise, relatively larger numbers of individuals are in the later stages of their lives, where they save in order to repay their mortgages and prepare for eventual retirement. On the flip side, there are relatively fewer younger people, who would typically borrow money for investments in housing or to bolster their consumption. Walker (2015) shows that domestic real interest rates across countries correlate negatively with the ratio of the size of the national population aged 50–75 to the size aged 0–49.

Other mechanisms for secular stagnation have been proposed. Summers (2015) notes that the world's demand for safe US financial assets acts to depress US interest rates. Moreover, low inflation expectations observed throughout the industrial world since the financial crisis in 2008 may well persist for many years.[16] Low inflation expectations can discourage business investment and limit the ability of central banks to use expansionary monetary policy to manage aggregate demand. Thus, the secular stagnation hypothesis suggests that interest rates will not rise substantially, making government borrowing cheap.

16. Summers (2015) conjectures that inflation expectations may remain muted for a decade or more.

Counter-arguments to the secular stagnation hypothesis for low interest rates are also made. Bernanke (2015) points out that there is little reason to believe that profitable investment opportunities would not arise anywhere in the world. Thus, investment demand in China and other emerging economic powers can place upward pressure on interest rates internationally. Furthermore, at the onset of the financial crisis in 2008, many economists warned of the effects that unprecedented expansions of the money supply would have on future inflation. That these effects have not yet been observed in markets is not a guarantee that inflation and both nominal and real interest rates will not rise rapidly once the US economy gains traction. It is sobering to recall that in 2010 the consensus Canadian private sector forecast of interest rates (on 3-month treasury bills) were expected to rise by 3.5 percentage points by 2015.[17] A well-known dictum of monetary economics is that policy affects economic activity with "long and variable lags."[18] Another mechanism by which interest rates may change in the future is through a higher premium demanded by lenders if rising debt levels put a government's credit worthiness in question. During the late 1980s to early 1990s, nearly every province experienced downgrades in Moody's credit rating. The cost of paying a higher interest rate on their debt had a disciplining effect on provincial government financial behavior (Kneebone, 1994).

The purpose of this paper is not to forecast interest rates. The hypothesis of persistent low interest rates may or may not materialize over the ensuing half decade. However, it would be imprudent to presume that an increase in interest rates by several percentage points cannot occur over the next few years. If the financial crisis of 2008 has taught macroeconomists anything, it is to contemplate the unexpected. Put differently, it is better for indebted governments to be prepared and prudent, than to be sorry later on.

17. See Chart 2.26 in the federal *Budget 2015*.
18. See McCandless and Weber (1995).

3 Estimating the Impact of Interest Rate Hikes in Ontario and Quebec

This section provides estimates of the impact of interest rate hikes in Canada's two largest provinces, which are also the most indebted provinces in terms of their net debt-to-GDP ratios. This sensitivity analysis of the impacts of an increase in real interest rates to more "normal" levels, over the four years 2016–17 to 2019–20, is based on the discussions in the previous section. The analysis assumes that the provincial governments roll their maturing bonds into new issues of 10-year provincial bonds, and uses the historical average real interest rate on 10-year Government of Canada bonds as a guide to construct the interest rate profiles. A 10-year bond is a reasonable choice of maturity length on new debt, given that the average term to maturity of Ontario and Quebec's debt is in this ballpark (10 to 15 years).

Two Scenarios for Interest Rate Hikes

This study considers two scenarios for the market interest rate on 10-year Government of Canada bonds. Scenario 1 assumes the market interest rate will rise to 3.5 percent in 2016–17 and then rise further to 4.5 percent in 2017–18 and remain there to 2019–20. Scenario 2 assumes that the rate will rise more rapidly, reaching 4.5 percent in 2016–17 and 5.0 percent from 2017–18 to 2019–20.

For comparison with these scenarios, Ontario's 2015 budget forecasts interest rates on Government of Canada 10-year bonds to be 2.7 percent in 2016–17, 3.8 percent in 2017–18, and 4.2 percent in 2018–19. The forecast for 2019–20 is not given, but it is reasonable to suppose that the government anticipates a continuation of the rise in rates to 4.5 percent.[19] Thus, in Scenario 1, interest rates are rising faster than expected by the Ontario government in its budgeting, but end up at the same level by 2019–20. In Scenario 2, rates reach a higher level than anticipated in 2019–20. Quebec's 2015 budget reports an expected interest rate of 2.6 percent for 2016, but it does not state its interest rate assumptions beyond 2016, even though spending and revenues are projected all the way to 2019–20. The analysis assumes that the medium-term projection of interest rates used in

19. It may appear odd to speak of the Ontario government's "expected rate" in 2019–20, when that year is beyond Ontario's budgeting horizon. However, 2019–20 is within the Quebec budget's horizon, hence the simulations are carried out to 2019–20. It should be noted that Ontario's budget provides forecasts for calendar years, rather than fiscal years, and the analysis assumes that the provincial forecast, e.g., for 2017, applies to 2017–18.

the Quebec government's budgeting are based on the same interest rates as given in the Ontario budget, and a value of 4.5 percent in the fiscal year 2019–20.

While the sensitivity analysis postulates higher interest rates than are assumed in the Quebec and Ontario governments' budgets, the sizes of the "shocks" are plausible and represent normal levels of real interest rates by historical standards. In the simulations, the two scenarios of upward interest rate shocks are contrasted with a base case scenario given by the governments' short- and medium-term outlooks.

The immediate impact of an increase in interest rates would be modest, because both provinces have structured their debt toward longer terms to maturity, to minimize the rollover risks associated with rising interest rates. Thus, Ontario's 2015 budget notes that every 1 percentage point (100 basis points) increase in interest rates over the full fiscal year in 2015–16 would cause the province's interest expense to rise by $400 million. Similarly, Quebec's 2015 budget states that a greater-than-anticipated rise in interest rates of 1 percentage point would increase the interest expenditure by roughly $250 million. However, over time, as more and more of the existing debt matures and must be rolled over at a higher interest rate, the cost of debt service would continue to rise. This study assumes that, following an interest rate upward shock, 10 percent of Ontario's debt is rolled over at the higher interest rate in the first year and 5 percent of the remaining stock of debt rolls over in each subsequent year. These proportions of maturing debt during the next five years are based on the maturity structure of Ontario's debt reported in the provincial budget. (See the Appendix for further details on the impact of these rollovers of debt on the provincial government's weighted average interest rate.) For Quebec, this report assumes the rollover rate to be 13 percent in the first year, based on the proportion of the province's debt exposed to variable interest rates, and that 7 percent of the remaining debt rolls over annually for the subsequent years.[20] Furthermore, as interest rates rise, the higher interest expense adds to the public debt, which in turn generates larger debt service costs in the following years. Indeed, this can become a vicious cycle, as was the case during Canada's debt crisis in the 1990s.

The model-based simulations of the impacts of rising interest rates begin with 2016–17, taking the debt levels in Ontario and Quebec for 2015–16 as given in the provincial budgets. A description of the model used for the simulations is provided in the Appendix. The main ingredients of the model are a debt accumulation equation, the projected short- and medium-term primary deficits (non-interest spending minus revenues) contained in the provincial budgets, and an equation

20. *Quebec Budget 2015–16* does not state its exposure to variable rates beyond the current year.

for the weighted average interest rate on provincial debt, which evolves with the interest rate on 10-year Government of Canada bonds.

A few caveats and explanations are in order. First, the primary deficits or primary surpluses reported in the provincial budgets are taken at face value. Furthermore, it is assumed that increases in interest rates do not change GDP growth or government non-interest spending and tax revenues. More realistically, governments may respond to interest rate shocks with modifications in fiscal policy. Moreover, economic growth itself is likely to be reduced if real interest rates rise. Indeed, Ontario's 2015 budget estimates that each 1 percentage point of sustained (unanticipated) increase in interest rates would likely reduce the forecasted growth rate by between 0.1 and 0.5 percentage points in the first year of the increase and by 0.2 to 0.6 percentage points in the second year. Reduced economic growth could by itself lead to higher debt and greater interest payments, if tax revenues are diminished by an economic slowdown. These potential complications are ignored in order to focus on the direct impact of higher interest rates on the cost of debt service. However, and quite critically, this implies that the following interest payment scenarios will likely *underestimate* the impact of higher interest rates on the governments' deficits.

Second, while Quebec provides a complete fiscal projection to 2019–20, Ontario's reported fiscal plan ends with 2017–18. Thus, for Ontario, this analysis assumes that the revenues and non-interest expenses grow at the rate of nominal GDP growth in 2018–19 and 2019–20. Nominal GDP growth is pegged at 4 percent, based on the long-term forecast contained in *Ontario's Long-Term Report on the Economy* (Ontario Ministry of Finance, 2014). Since Ontario's 2015 budget projects a balanced budget in 2017–18, this implies that the province will have a primary surplus (revenues exceeding non-interest expenses). Thus the assumption that revenues and primary expenses would henceforth grow at 4 percent as of 2017–18 implies that the primary surplus will be growing, which by itself would tend to lower the size of the provincial debt in 2018–19 and 2019–20. It is rather unlikely that the primary surplus in Ontario would grow at the rate of GDP in 2018–19 and 2019–20, since the province has struggled with its finances and has announced an ambitious infrastructure spending program for the next decade. However, the assumption that revenues and non-interest expenses will grow at the rate of economic growth, following the government's planning period, is intended as a "neutral" forecast, so that one can focus on the effects of interest rate changes, rather than mixing those effects with the impacts of additional program spending relative to revenues. Similarly, the analysis takes for granted that Quebec will achieve its plan of substantial primary surpluses starting next year, even if meeting those targets will prove to be challenging. For these reasons, in the presentation of results, the focus is on how interest rate shocks *change* provincial interest payments and budget deficits.

Results of the Analysis for Ontario

Table 1 displays the results of the first and second interest rate hike scenarios for Ontario. The table is divided into three sections. The top section gives the base case scenario, which consists of the government's budget projections from 2015-16 to 2017–18, plus the model-based projection for the years 2018-19 and 2019–20. Information is provided on the interest rate assumption for Government of Canada 10-year bonds, the interest cost of debt (in millions of dollars), and the interest bite, equal to the interest cost as a proportion of total revenues. The second section of the table shows the impact of the Scenario 1 interest rate shock, which assumes a modest increase in the interest rate above the Ontario government's projection in 2016–17, followed by a further unanticipated modest increase in the following years, except in 2019–20 when the rate is identical to the rate presumed to be anticipated by governments (though unannounced in the budget). In this scenario, interest rates still remain below their historical norm throughout the medium-term horizon. The third section gives the impact of rising interest rates for Scenario 2, in which rates return to the historical norm by 2017–18 and remain above the rates expected by the governments in their fiscal plans.

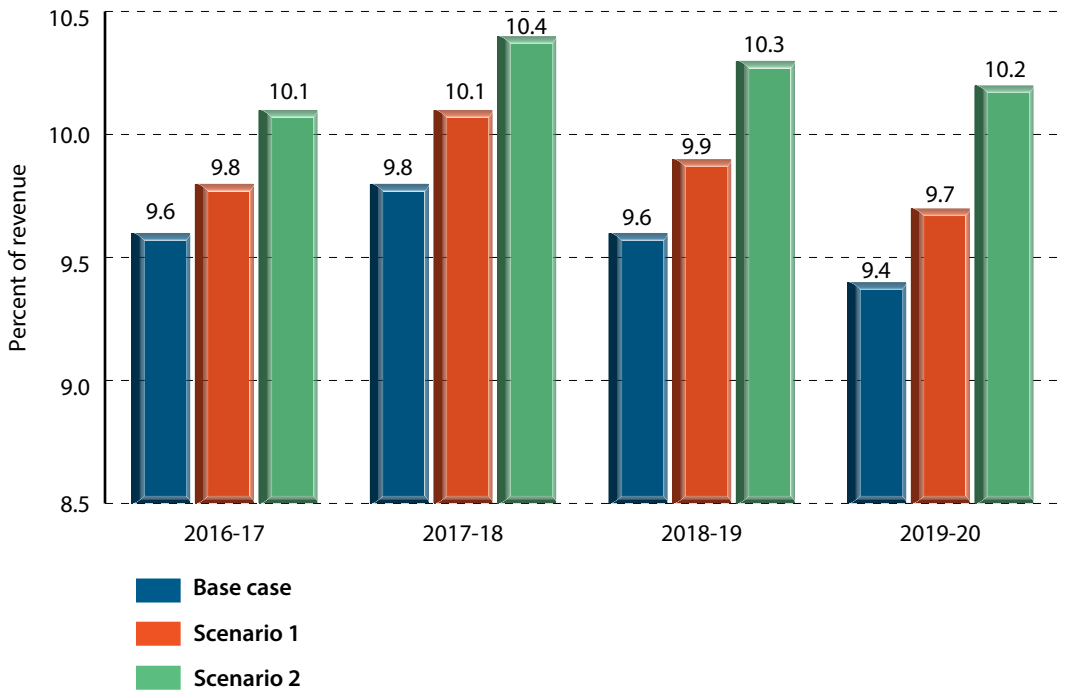
Table 1: Ontario Interest Rate Scenarios

	2015–16	2016–17	2017–18	2018–19	2019–20
Base case scenario: Interest rates remain below normal	*Ontario's 2015 budget Medium-term outlook*			*Model's projection*	
Interest rate projection (10-Year Government of Canada bonds)	1.80%	2.70%	3.80%	4.20%	4.50%
Interest cost of debt ($ millions)	$11,400	$12,400	$13,200	$13,430	$13,688
Interest bite	9.20%	9.60%	9.80%	9.60%	9.40%
Scenario 1: Interest rates rise to 3.5% in 2016–17 and 4.5% in 2017–18	*Budget*	*Model's projection*			
Change in interest rates (percentage points)	0	0.8	0.7	0.3	0
Change in interest cost of debt ($ millions)	$0	$274	$409	$478	$498
Change in interest bite (percentage points)	0	0.2	0.3	0.3	0.3
Scenario 2: Interest rates rise to 4.5% in 2016–17 and 5.0% in 2017–18	*Budget*	*Model's projection*			
Change in interest rates (percentage points)	0	1.8	1.2	0.8	0.5
Change in interest cost of debt ($ millions)	$0	$616	$857	$1,032	$1,164
Change in interest bite (percentage points)	0	0.5	0.6	0.7	0.8

The outcome of the modestly higher path for interest rates in Scenario 1, where rates rise from 2.7 percent in 2016–17 to 3.5 percent, and then to 4.5 percent in the following years, is an increase in interest payments (relative to the government's projection) by $274 million in 2016–17, and by about $400 to $500 million in each of the remaining three years of the medium term.[21] Since the simulation analysis takes non-interest spending and total revenues as fixed, the additional interest expense would turn the provincial government's anticipated budget balance in 2017–18 into a deficit of $409 million. The interest bite would rise, peaking in 2017–18, when 10.1 percent of Ontario's revenues would be allocated to debt service (**figure 5**), compared to 9.2 cents per dollar in 2015–16.

Scenario 2, where real interest rates return to their historical average, would pose a serious risk to the province's finances. In 2017–18, when the government is expecting to balance its budget, the interest payments on public debt would rise by $857 million more than anticipated in the government's budget and would translate into a deficit of the same magnitude. Cumulatively, over the four year period from

Figure 5: Ontario's Interest Bite, 2016–17 to 2019–20

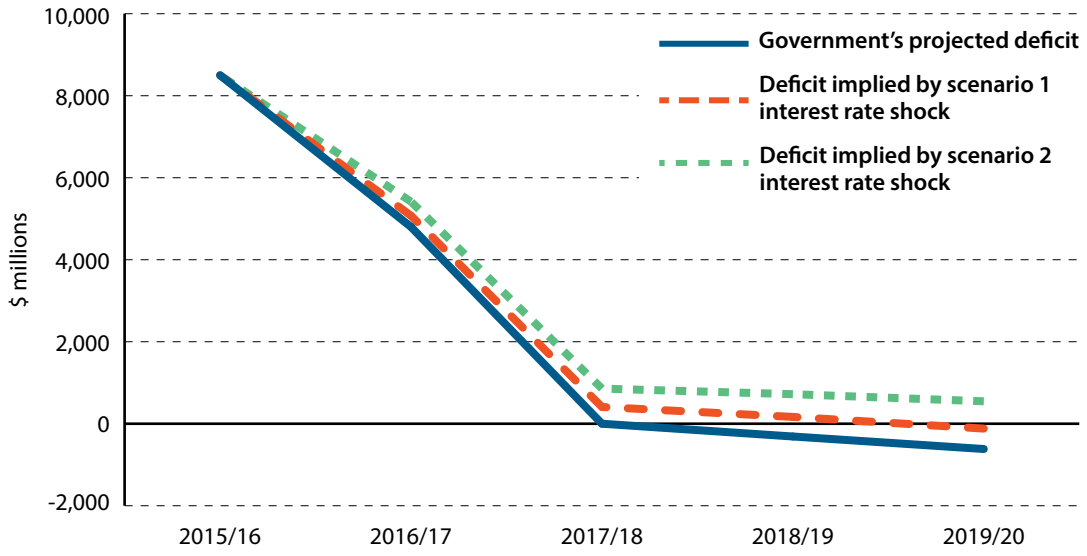


21. Note that interest payments rise the most in 2019–20, despite an unanticipated interest rate shock of zero in that year. This is due to the model's debt accumulation dynamics, whereby the effect of positive interest rate shocks in previous years translates into greater interest payments in the future. However, the interest bite is highest in 2018–19, as the projection assumes that Ontario's revenues are trending at the rate of GDP growth after 2017–18.

2016–17 to 2019–20, the cost of debt service increases by $3.7 billion. The interest bite would rise by 0.5 percentage points, to 10.1 percent of revenues, in 2016–17, and by 0.8 percentage points above the base case in 2019–20, to 10.2 percent. It is worth reminding readers that these are conservative estimates, because government spending is assumed to increase only at the rate of nominal GDP growth. Actual spending since 2008 has grown much faster than this. The government of Ontario has tried to reassure financial markets that it is on track to restore budgetary balance. If the interest rate in Scenario 2 were to occur, which is certainly not an implausible event, then, unless Ontario is able to generate substantial primary surpluses by restraining program spending below revenue collection, further credit downgrades would seem likely. Such downgrades may themselves result in higher interest rates on the government's debt, leading to a vicious cycle.

Figure 6 graphs the projected Ontario budget deficit in the base case against the deficits arising from the two interest rate shock scenarios.[22] The projection of Ontario's deficit *levels* in 2018–19 and 2019–20 must be taken with a grain of salt, given that spending and revenues are both assumed to grow at the rate of GDP, implying a growing primary surplus in each year. Nevertheless, the graph clearly shows that if interest rates in Scenario 2 were to materialize, Ontario's pronouncement of achieving a balanced budget in 2017–18 (and beyond) would be derailed. And this is under fairly conservative assumptions about the future state of government finances.

Figure 6: Ontario's Budget Deficits With and Without Higher-than-Anticipated Increases in Interest Rates



Sources: Ontario's 2015 budget and projections using author's model.

22. By construction, the gap between the projected deficits in base case and the deficits in the Scenarios 1 and 2 is exactly equal to the change in interest payments, as noted earlier.

Results of the Analysis for Quebec

Quebec's 2015 budget describes a plan for producing budget surpluses and reducing public debt, starting in the current fiscal year (2015–16). Even with interest rates returning to more normal levels as outlined in Scenario 2, Quebec would achieve budget surpluses throughout the projection horizon. However, the interest rate increases would reduce the sizes of the surpluses and, like in Ontario, would make the interest bite higher than it is presently forecasted. **Table 2** displays the results of the simulations for Quebec.

Table 2: Quebec Interest Rate Scenarios

	2015–16	2016–17	2017–18	2018–19	2019–20
Base case scenario: Interest rates remain below normal	***Quebec's 2015 budget Medium- and long-term outlook***				
Interest rate projection (10-Year Government of Canada bonds)	1.70%	2.60%	3.80%	4.20%	4.50%
Interest cost of debt ($ millions)	$10,483	$10,934	$11,129	$11,373	$11,567
Interest bite	10.50%	10.60%	10.50%	10.50%	10.40%
Scenario 1: Interest rates rise to 3.5% in 2016–17 and 4.5% in 2017–18	***Budget***	***Model's projection***			
Change in interest rates (percentage points)	0	0.9	0.7	0.3	0
Change in interest cost of debt ($ millions)	$0	$248	$363	$423	$440
Change in interest bite (percentage points)	0	0.2	0.3	0.4	0.4
Scenario 2: Interest rates rise to 4.5% in 2016–17 and 5.0% in 2017–18	***Budget***	***Model's projection***			
Change in interest rates (percentage points)	0	1.9	1.2	0.8	0.5
Change in interest cost of debt ($ millions)	$0	$524	$725	$876	$986
Change in interest bite (percentage points)	0	0.5	0.7	0.8	0.9

In Scenario 1, where interest rates rise from 2.6 percent to 3.5 percent in 2016–17 and to 4.5 percent in each subsequent year, annual interest payments are projected to rise by $248 million in the first year of the shock, and by $440 million by 2019–20. Scenario 2 shows an increase of $524 million in 2016–17 and nearly $1 billion in 2019–20. The cumulative increase in interest payments in Quebec, as a result of the return of interest rates to normal levels, is $3.1 billion over four years in Scenario 2. This is a substantial amount; by way of comparison, it would eat up 62 percent of the province's combined budget surpluses in 2016–17 and 2017–18 expected in Quebec's 2015 budget. Furthermore, the expected surpluses will already not be easy to achieve as they require the government to hold firm on significant spending restraint. In Scenario 1, the interest bite rises from its value of 10.5 percent in 2015–16 to 10.8 percent in 2019–20 (**figure 7**). In Scenario 2, the interest bite reaches 11.3 percent in 2018–19 and 2019–20.

Figure 7: Quebec's Interest Bite, 2016–17 to 2019–20

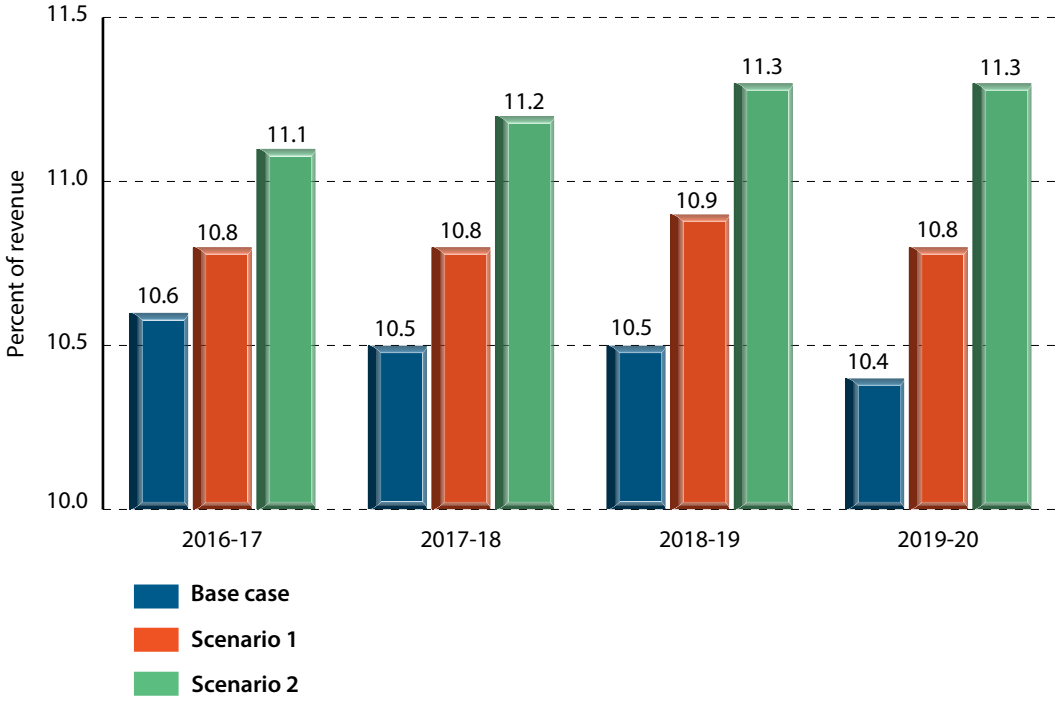
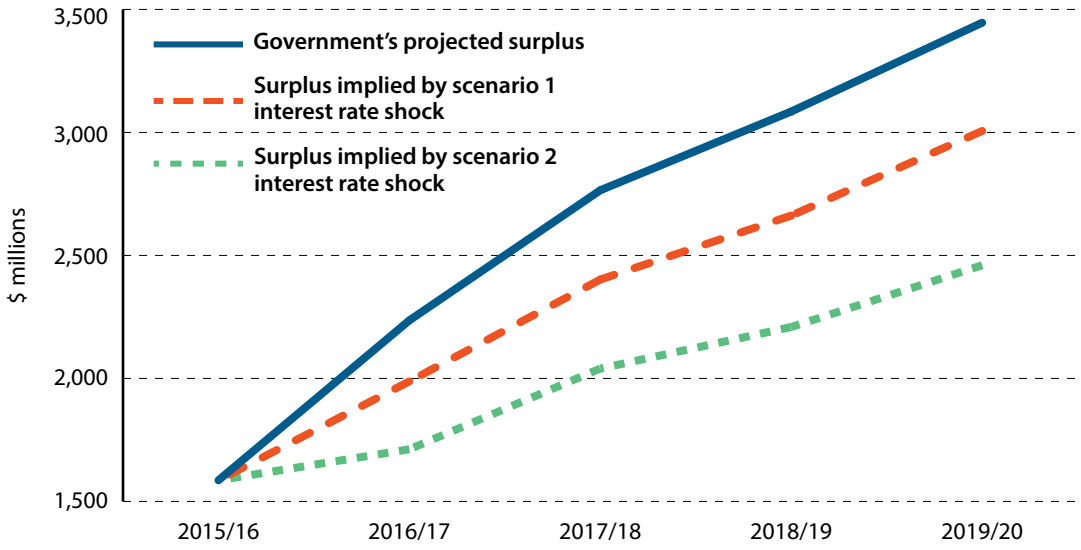


Figure 8 shows the level of Quebec's *projected* budget surpluses (the opposite of budget deficits) from 2015–16 to 2019–20, as given in Quebec's 2015 budget, versus the interest rate shock scenarios of higher than expected interest rates. The sizes of the surpluses are cut substantially in the case of Scenario 2.

Figure 8: Quebec's Budget Surpluses With and Without Interest Rate Shocks



Sources: Quebec's 2015 budget and projections using author's model.

4 Long-Run Impact of Higher Interest Rates

The preceding analysis examined the short- and medium-term budget impacts of greater than anticipated interest rate hikes. Because provincial governments have reduced their exposure to rollover risk by locking into longer-term bond maturities, the consequences of potentially higher interest rates are somewhat mitigated. However, over a long time horizon most or all of the current debt will be exposed to these higher interest rates. This section provides a measure of the budgetary impact of interest rates on provincial debt remaining permanently at a 5 percent level, with 2 percent inflation and hence a real rate of 3 percent. The 5 percent interest rate on provincial debt would correspond to a rate of 4.5 percent on 10-year Government of Canada bonds plus half a percentage point provincial risk premium.[23] These are very optimistic assumptions for the long run, which likely understate the impact of rising interest rates.

Using Equation 4 in the appendix, we can calculate the change in the primary surplus (revenues less non-interest spending) as a percentage of GDP that is required to offset a permanent increase in the interest rate, so as to maintain the ratio of gross debt-to-GDP at constant level.[24] Using the symbol Δ to denote the "change in" a variable, this relationship can be written as:

$$\Delta(\text{Primary surplus/GDP}) = \text{Debt/GDP} \times \Delta\,\text{Interest rate} \div (1 + \text{growth rate of GDP})$$

This equation says that, if the debt-to-GDP ratio is to be stable at, say, the level projected for 2016–17, then the primary surplus (as a share of GDP) must

23. The half percentage point provincial risk premium is based on the discussion in Quebec's 2015 budget regarding the spread on Quebec's bonds and federal bonds prior to the 2008–09 recession. Hence, the long-term projection in this analysis incorporates a smaller interest rate spread for both Ontario and Quebec than the currently observed spread of 1 percentage point. Note also that the assumption of a 4.5 percent rate on Government of Canada bonds forever is a modest interest rate, corresponding to the final interest rate in Scenario 1, rather than the final rate supposed in Scenario 2.

24. This requires D/GDP to equal $(D/GDP)_{-1}$ in Eq. 4 of the appendix. The equation can then be rewritten as $\left(\frac{T-S}{GDP}\right)=\left(\frac{R-G}{1+G}\right)\left(\frac{D}{GDP}\right)$ where D/GDP refers to the value of the debt ratio immediately preceding the permanent interest rate increase, and (T-S)/GDP is the primary surplus as a share of GDP. Since the growth rate of the economy, G, is assumed to be constant, a change in the interest rate R implies a particular change in (T-S)/GDP if D/GDP is to remain fixed.

increase, through lower spending, by an amount equal to the change in the interest rate, divided by one plus the rate of growth of the economy. Now suppose we expect interest rates on provincial bonds to rise permanently by 1 percentage point (i.e., Δ interest rate = 0.01). This would correspond, for example, to Ontario's average weighted interest rate on its public debt rising from its current level of about 4 percent to 5 percent. This, in turn, is consistent with an interest rate on Government of Canada bonds of 4.5 percent plus a provincial risk premium of 0.5 percentage points. These are very mild assumptions, in which the Government of Canada bond rate remains below the historic average rate even in the long run (as in Scenario 1 in the previous section) and the spread between the federal and provincial rates reverts to its pre-2008–09 recession level of half a percentage point, down from the currently observed spread of 1 percentage point.

Assume the long-run growth rate of nominal GDP in Ontario is 4.1 percent (i.e., 0.041), as projected by the Ontario Ministry of Finance (2014). The gross debt-to-GDP ratio in Ontario in 2016–17 is expected to be about 45 percent (i.e., 0.45). Plugging these numbers into the equation suggests that the primary surplus as a percentage of GDP will have to increase by about 0.44 percent (i.e., 0.0044). Finally, multiplying this number by the nominal GDP figure expected by the government of Ontario in 2016–17 (i.e., $786.6 billion on a fiscal year basis), yields a required *increase* in the primary surplus each year (forever) of about $3.5 billion. Anything less than that amount would cause the gross debt-GDP ratio to rise above its 2016–17 level. To put this figure into perspective, Ontario's 2015 budget projects a *primary* surplus of $7.6 billion in 2016–17 and $13.2 billion in 2017–18. Having to find another $3.5 billion in surplus funds each year in order to meet the higher interest payments would be difficult. But otherwise, the debt-to-GDP ratio would rise and remain above the 2016–17 level over the long run.

A similar calculation for Quebec suggests that a 100 basis point permanent increase in interest rates would require the primary surplus to be increased by $2.1 billion annually to keep the debt ratio constant at its 2016–17 level.[25] For comparison, Quebec's 2015 budget projects a primary surplus of $13.1 billion and $13.9 billion in 2016–17 and 2017–18, respectively. These surpluses are projected by the government under its assumption that spending growth will be restrained to 2.3 percent in 2016–17 and to 2.8 percent in each subsequent year. Clearly, a 1 percentage point increase in interest rates permanently would create a significant challenge for Quebec's stated objective of reducing the gross debt from 54 percent in 2016 to 45 percent in 2026.

25. The analysis assumes that long-run nominal GDP growth will be the same in Quebec as in Ontario at 4.1 percent; Quebec's gross debt-to-GDP ratio in 2016–17 is projected in Quebec Budget 2015–16 to be 53 percent and the value of Quebec's nominal GDP is expected to equal $406.5 billion (on a fiscal year basis).

5 Conclusions

While the federal and many provincial governments in Canada have experienced rapidly rising debt since the 2008–09 recession, the cost of servicing the debt has been cushioned by the fact that interest rates are, and have been since the recession, at levels that are very low by historical standards. Many forecasters of interest rates expect rates to rise eventually. Indeed, the fiscal outlook of the Ontario Ministry of Finance also projects higher interest rates in the medium and longer terms. No one can say with confidence when, or even if, interest rates will rise. But they are currently at such low levels, that the risk is clearly in the upward direction. The question posed in this paper is how sensitive are the government's budgetary outlooks to the possibility that interest rates will return to normal levels more rapidly than expected. While the focus of the quantitative analysis is on Quebec and Ontario, Canada's two most indebted provinces, the results are qualitatively relevant for almost all provincial governments, which have also seen their debt burdens rise substantially since the recession in 2008–09.

This study constructed a model to calculate the effects of higher interest rates on the government budgets for Ontario and Quebec from 2016–17 to 2019–20. The simulations suggest that Ontario's plan to achieve a balanced budget in 2017–18, after nine consecutive deficits, would be derailed if interest rates in 2017–18 are 4.5 percent instead of the 3.8 percent assumed in Ontario's 2015 budget. If rates were to rise to 5 percent, which is still slightly below the Ontario government's own long-term interest rate forecast, the province would likely run a deficit exceeding $850 million in 2017–18, instead of its promised balanced budget. The cumulative increase in interest payments over four years would equal $3.7 billion. The province's interest bite would reach 10.4 percent of revenues in 2017–18, and then decline slightly to 10.2 percent by 2019–20 if spending and revenues are assumed to grow at the same rate of GDP from 2018-19 to 2019–20.

The analysis for Quebec has a somewhat different flavour. While it is the case that the interest payments on public debt would rise in Quebec, more or less similarly to Ontario, the increase in interest rates would not turn Quebec's projected surpluses into deficits. The reason for this is that the Quebec government expects to generate large surpluses in the absence of interest rate shocks. Nonetheless, if interest rates return to normal levels, the province's surpluses would be reduced and the proportion of Quebec's revenues used to pay interest on the debt would approach 11.3 percent of revenues by 2019–20, instead of the 10.4 percent currently projected by the government for that year.

For the next five years, only between one-quarter and one-half of the public debt of Ontario and Quebec is scheduled to mature and hence be rolled over at potentially higher interest rates. This implies that the governments are somewhat protected from the risk of higher interest rates for several years. This should not lull the governments and their citizens into a false sense of security against interest rate risks. As is shown here, if interest rates were to rise permanently by 1 percentage point, say from 4 to 5 percent, then the adverse budgetary impact on Ontario and Quebec would be much more severe in the long run than in the medium term. This is because eventually all of the public debt is exposed to the higher interest rates. The analysis in this report estimates that a permanent 1 percentage point increase in interest rates would require Ontario and Quebec to decrease their program spending or increase tax revenues by $3.5 and $2.1 billion, respectively, each year, to prevent the provincial debt from rising relative to the size of the provincial economy. This would be a tall order and points to the benefits of restraining spending growth in order to reduce the size of the public debt, even while interest rates currently remain historically low.

In addition to testing the sensitivities of the short- and medium-term fiscal outlooks in Ontario and Quebec to faster-than-expected interest rate hikes, the paper provided an extended discussion of interest rates and the composition of government debt, serving as a background for understanding how interest rates impact public finances.

An important bottom line from this investigation of provincial finances is that governments and their citizens should not be sanguine about the interest rate environment. It is certainly noteworthy that provincial governments have actively and wisely structured their debt maturities toward the long term, in order to benefit from currently low interest rates and to minimize their exposures to rising interest rates. However, their budget projections for the medium term assume that real interest rates will remain below their historical average. While this assumption is not unreasonable in itself, it becomes problematic if the assumption is crucial for delivering on promises of a balanced budget or debt-reduction strategies. In the case of Ontario, especially, a faster-than-expected rise in interest rates toward normal levels could upset an already delicate path toward fiscal sustainability. In Quebec, the danger is mitigated to some extent by the government's commitment to fiscal reforms, announced in its latest budget, to achieve annual surpluses through spending cuts. Should the government waver on its commitment, then the interest rate risk would exacerbate the province's already very high debt-to-GDP ratio.

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Appendix

The model used to track the effect of interest rate changes on the budgets of the Ontario and Quebec governments is based on the basic equation of public debt accumulation, which states that the stock of debt this year equals the stock of debt last year with interest, plus the difference between this year's non-interest expenses and revenues. It may be expressed as:

Eq. 1 $$D = (S - T) + (1 + R)D_{-1}$$

where D denotes the debt at the end of the current fiscal year, D_{-1} is the debt at the end of the previous year, R is the weighted-average interest rate on the debt, S is program spending (excluding interest on debt), and T is taxes and other revenues. The expression $(S - T)$ is called the primary deficit, or surplus, if it is negative. More generally, it is referred to as the "primary balance."

Before proceeding further, some technical details should be noted. D is taken to be *gross* public debt, meaning the total liabilities of the government, which includes provincial direct debt (bonds) and financial liabilities, such as public sector pension obligations.[26] The weighted-average interest rate reported in the budget documents refers to interest on direct debt. By applying the weighted-average interest rate to all of the gross debt, it is assumed implicitly that the interest rate for pension liabilities is the same as the average interest rate on direct debt.

Furthermore, in the governments' fiscal outlooks, total revenues encompass the returns on financial assets, including the revenues earned by its crown corporations. This analysis takes these returns and earnings as being fixed, but, in fact, the return on the financial assets of a government will change with interest rates. As interest rates rise, the investment income of the governments should increase, although the profits of Crown corporations may fall due to lower economic activity. In the absence of a complete financial model of the governments' assets, it is not feasible to accurately evaluate the effect of higher interest rates on government revenues from its assets. Hence, the investment revenues are here kept fixed

26. The concepts of gross debt are generally not identical across provinces. Quebec Budget 2015-16 compares gross debt levels across provinces and indicates that Quebec's reported gross debt corresponds to Ontario's so-called "total debt" plus the debt of its Broader Public Sector Organizations (BPSO). Hence the model uses Quebec's reported gross debt and Ontario's total debt plus the debt of the BPSO. Note, too, that Quebec's reported gross debt is net of the province's Generations Fund.

across interest rate scenarios. In any case, the amount of interest-bearing financial assets of the Quebec and Ontario governments is small in comparison to the sizes of their direct debts.

Recall that R should be interpreted as a weighted-average interest rate on the provincial government's debt. If interest rates rise over time, then the weighted-average interest rate will evolve as the debt matures and is subject to rate resetting. This report shall assume that all new borrowing is done by issuing 10-year provincial bonds, with an interest rate equal to the Government of Canada 10-year bond rate, plus a one percent spread for both Ontario and Quebec. Denote the proportion of debt rolling over in year t by w_t and the year-t interest rate on 10-year provincial bonds as r_t. Call the year prior to the interest rate shock year 0 and suppose that in that year the weighted average interest rate is R_0.

Then, a simple model for the evolution of the weighted-average interest rate, R_t, is:[27]

Eq. 2 $$R_t = (1 - w_1 - w_2 ... - w_t)R_0 + w_1 r_1 + w_2 r_2 + ... w_t r_t$$

where $w_1 + w_2 + ... w_t < 1$ over the 5-year post-shock time horizon portrayed in tables 1 and 2. Since any newly rolled over debt would mature only in 10 years, none of the new bond issues would be rolled over during this report's medium-term projection horizon.

The weighted-average interest rate reported in Ontario's 2015 budget and in *Quebec Budget 2015–2016*, when multiplied against the gross debt (at the end of the previous year), tends to under- or over-predict the cost of interest reported in the budget in any given year. This is partly due to the fact that the reported cost of interest also includes the cost of managing the debt, as noted in a footnote in Ontario's budget document. This cost could include such elements as fees and the cost of derivatives. Another reason for the discrepancies between the cost of interest reported in the provincial budgets and the model-based simulations is likely due to the fact that the interest rate on direct debt may differ from the interest rate applicable to other government liabilities. In the case of Quebec, the positive deviation between the five-year forecast of interest payments in Quebec's 2015 budget and model's predictions is probably mainly attributable to the capital budgeting method used in government financial reporting. This means that new capital expenditures contribute to the reported budget deficit only through depreciation and amortization expenses, rather than directly through new borrowing, even though such borrowing adds to the size of the actual debt. Thus when a

27. The equation assumes implicitly that the stock of year-0 debt that matures in each year carried the same interest rate as the weighted-average interest rate.

province ramps up capital expenditures and finances these acquisitions with debt, the debt will rise faster than is reflected in the primary deficits that enter the debt equation Eq. 1 via the expression (*S* - *T*).[28] Indeed, Quebec's 2015 budget (Table E3) shows net capital investments of about $12 billion over the period 2015–16 to 2019–20 offsetting much of the anticipated budget surpluses from cuts to current spending.[29] Thus, to improve the accuracy of the model, a lump-sum adjustment to the weighted average interest rate is added for each province.[30] For Ontario, the adjustment to the weighted-average interest rate is negative, but small in magnitude (about 20 basis points). For Quebec the adjustment is positive and of a considerably larger magnitude, at about +150 basis points. The lump-sum adjustments to the weighted-average interest rate are necessary to reconcile the *level* of the cost of debt service with the model's estimates of interest payments, but the adjustments will have little bearing on the *change* in interest payments resulting from increases in interest rates. It is the change in the size of interest payments that we are interested in.

While the Quebec budget provides an extended outlook until 2019–20, the corresponding interest rate assumptions are not provided beyond 2016. Therefore, it is unclear exactly what interest rate the budget forecast is based off. This study presumes that the Quebec government's forecast for 2017–18 is based on an interest rate of 3.8 percent (i.e., the same as given in the Ontario budget); for 2018–19 and 2019–20, it assumes that the interest rates anticipated by both governments are 4.2 percent and 4.5 percent, consistent with the view expressed in Ontario's 2015 budget of a gradual upward trajectory for interest rates.

It is convenient to express the variables in Eq. 1 in terms of shares of GDP. In this way, the projected growth of GDP can be included in the model. Hence, dividing both sides by the current fiscal year's provincial GDP gives:

Eq. 3 $$\frac{D}{GDP} = \frac{(S-T)}{GDP} + (1+R)\frac{D_{-1}}{GDP}$$

28. The accounting cannot be adjusted to a cash basis because the provincial budgets do not provide a projection of depreciation expenses.

29. The Ontario government also plans to increase capital investments over the next decade, but given that Ontario's 2015 budget projects only to 2017-18, the model's annual predictions for interest payments and gross debt are close to the figures implied in the government's forecast.

30. This adjustment is equivalent to raising the province's stock of debt carried over from the previous period, in order to account for the impact of debt-financed capital investments.

Further, note that, by definition, GDP this year must equal GDP last year times one plus the growth rate of GDP. Letting *G* stand for the growth rate of GDP, Eq. 3 can be rewritten to give its final form:

Eq. 4
$$\frac{D}{GDP} = \frac{(S-T)}{GDP} + \frac{(1+R)}{(1+G)}\frac{D_{-1}}{GDP_{-1}}$$

Eq. 4 says that the gross debt-GDP ratio in the current year equals the ratio of the primary deficit (*S* - *T*) to GDP, plus the ratio of gross debt-GDP in the previous year, times the ratio of (1+*R*) to (1+*G*).[31] The projections use the provincial governments' actual forecasts of the primary balance, except for the years 2018–19 to 2019–20 in Ontario, since those years are beyond the fiscal outlook in Ontario's 2015 budget. For those years, the primary balance is assumed to grow at the same rate as GDP (which is assumed to be 4.1 percent). Eq. 4 and Eq. 2, together with the forecast of GDP growth, form the basis of this report's projections of interest payments on public debt, taking the debt level in 2015–16 as an initial value.

31. See also Kneebone and Gres (2013) for use of this equation to analyze the evolution of Ontario's public debt.

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