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Is Public Debt Reduction Worthwhile?

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EXECUTIVE SUMMARY

This paper examines whether reducing Canada's federal debt is a worthwhile policy objective, in light of economists' advice and public opinion favouring debt reduction. As well, the federal government has projected a gradual decrease in its debt-to-GDP ratio over the next 30 years. Reducing the public debt means that governments have to adopt a policy of fiscal austerity. This paper focuses on the trade-offs of fiscal austerity — short-term sacrifices for long-term benefits.

Debt reduction requires governments to maintain a higher primary budget balance in the short term, often through reduced public spending or increased taxes. Initially painful, this fiscal austerity yields several long-term benefits: lower interest payments, improved economic growth, reduced fiscal risks from future economic shocks and greater flexibility for public spending or tax cuts once the debt ratio stabilizes at a lower level. Reducing debt also acts as fiscal insurance, mitigating the burden of stabilizing debt ratios during future economic crises.

The benefits of debt reduction depend on factors such as the discount rate society applies to future gains and the extent to which lower debt levels will reduce interest rates, boost growth and diminish risks of debt crises. Using a Monte Carlo model of debt dynamics, the study evaluates a 12-percentage-point reduction in Canada's federal debt-to-GDP ratio over 10 years. The analysis finds that such a policy would pass a cost-benefit test if a discount rate of four per cent or less is applied. The biggest benefits come from fiscal insurance and growth rate effects, leading to substantial long-term welfare gains.

There is increasing pressure on governments globally to adopt restrictive fiscal policies following the 2008–09 financial crisis and the 2020–21 COVID-19 pandemic. For example, the European Union has introduced fiscal adjustment rules requiring member states with high debt levels to reduce their ratios incrementally. In Canada, polling shows significant public support for spending cuts.

A lower debt-to-GDP ratio reduces interest costs, freeing resources for other priorities. Reducing debt levels contributes to lower interest rates, further easing fiscal pressures. Lower debt ratios are linked to higher economic growth, benefiting households through increased incomes and fiscal stability. Reduced debt levels also provide governments with a greater capacity to respond to economic shocks without worsening the fiscal burden.

These benefits must be weighed against the immediate costs of fiscal austerity, including constrained public services and higher taxes during the adjustment period. The viability of debt reduction depends heavily on the societal discount rate, which reflects the value placed on future benefits versus present sacrifices.

This analysis supports the argument for targeted debt reduction in Canada, provided the discount rate remains low and the anticipated benefits, such as fiscal insurance and economic growth, materialize. While fiscal austerity imposes short-term hardships, the long-term gains make a compelling case for reducing the federal public debt.

1. INTRODUCTION

In the aftermath of the financial crisis of 2008–09, and pandemic of 2020–21, governments around the world are faced with much higher public debts and are under pressure to adopt more restrictive fiscal policies to reduce their debt-to-GDP ratios. For example, the EU Commission has revised its fiscal adjustment rules under its Stability and Growth Pact, such that "countries with a debt-to-GDP proportion above 90 percent should reduce the ratio by an annual average of 1 per cent within a four or five-year time frame that can be extended to seven" (Sorgi, Smith-Meyer, Leali and Mackenzie 2023). EU countries with debt ratios between 60 and 90 per cent can adopt a lower annual adjustment rate of 0.5 per cent.

The size of Canada's public debt has also come under scrutiny. In May 2024, the C.D. Howe Institute hosted a conference called Does Canada Have a Debt Problem? Speakers raised concerns about a looming provincial debt crisis and argued for a 10-percentage-point reduction in Canada's debt-to-GDP ratio to provide resilience to future economic shocks (Lester and Robson 2024). Laurin (2020) notes that "High-debt countries experience larger increases in interest rates in response to unexpected change in economic conditions and volatility. In addition, public debt carries economic costs beyond the interest charges because of lost future investment crowded out by higher taxes and/or interest rates." He argued that the federal government should lower its post-pandemic public debt by one percentage point a year for 15 years. Lester (2021) has advocated reducing the pandemic-related public debt to promote intergenerational equity. Reducing the federal debt also seems to have strong public support in Canada. A recent public opinion poll indicates that a plurality (37.8 per cent) favour cutting federal spending to repay debt (Platt 2024). Perhaps in response to economists' advice and public sentiments, the federal government is projecting a gradual reduction in its debt ratio over the next 30 years (Government of Canada 2023a).

The benefits from reducing public debt can be broken down into four components. First, a lower public debt, holding interest rates and growth rates constant, reduces a government's interest payments, and it can stabilize its debt ratio with a lower primary budget balance. This means that program spending can be higher and/or taxes lower in the future. Second, lower public debt ratios are associated with lower interest rates on the public debt, further reducing interest payments and the primary balance required to stabilize the debt ratio. Third, a considerable body of economic research indicates that slower economic growth is associated with higher debt-to-GDP ratios. Dahlby, Ferede and Fuss (2022) sum up the literature on this topic. To the extent that a lower debt ratio boosts the growth rate, there is a direct benefit to households through higher incomes as well as an indirect benefit in lowering the primary budget balance required to stabilize the debt ratio. Finally, a lower public debt can provide fiscal insurance against future economic shocks, such as occurred during the financial crises of 2008–09 or pandemic of 2020–21. During major recessions, governments can run large deficits as revenues decline and expenditures on employment insurance and other transfers increase, ratcheting up the public debt. Having a lower debt ratio when a major downturn occurs reduces the burden of stabilizing the debt ratio in the post-recession period.

While debt reduction provides these benefits, it also requires a period of fiscal austerity — lower program spending and/or higher tax burdens than would otherwise be necessary to stabilize the debt ratio. Debt reduction is therefore a classic example of short-term pain for long-term gain. Whether fiscal austerity passes a cost-benefit test depends not only on the future fiscal and economic benefits associated with a lower debt, but also on how the public values

those future gains relative to short-term losses. As we will show, the discount rate that is used to evaluate a policy to reduce the debt is important, not only for comparing the short-term fiscal hardships with the future fiscal and economic benefits, but also for determining the optimal fiscal policy during the period of fiscal austerity.

Not surprisingly, the answer to the question we pose in this paper depends on the discount rate as well as the extent to which debt reduction lowers interest rates, boosts the rate of economic growth and reduces the fiscal risks from future economic shocks. We use a Monte Carlo model of debt dynamics to evaluate the welfare effects of a 12-percentage-point reduction in the Canadian federal debt-to-GDP ratio over a 10-year period. The model indicates that this fiscal policy would pass a cost-benefit test if a discount rate of four per cent or less is used to evaluate the future benefits from a lower public debt ratio. The expected present value of the net gains from debt reduction are substantial with the largest source of gains from fiscal insurance and growth rate effects.

The paper is organized as follows. In Section 2, we develop a measure of the fiscal cost of the public debt, i.e., the welfare loss from lower program spending and/or higher taxes in financing interest payments on the public debt. This measure differs from the conventional measures of the burden of the public debt — interest payments on the public debt as a share of tax revenue or GDP — because it also depends on the marginal cost of public funds and the economy's growth rate. In Section 3, we use this measure of the fiscal cost of public debt in a model of debt dynamics to calculate the welfare gains or losses from reducing the public debt to determine whether a period of fiscal austerity is worthwhile. The details of these models are contained in three technical appendices. We show that the optimal trajectory for the debt-to-GDP ratio during fiscal austerity depends on the difference between the real interest rate and the growth rate of the economy, $r-g$, and the society's rate of time preference, ρ. The model indicates that reducing the federal debt by 12 percentage points over 10 years would pass a cost-benefit test if a discount rate of less than five per cent is used to evaluate the future benefits from a lower public debt ratio. The expected present value of the net gains from debt reduction are substantial with the largest source of gains from fiscal insurance and growth rate effects. The last section contains some concluding remarks.

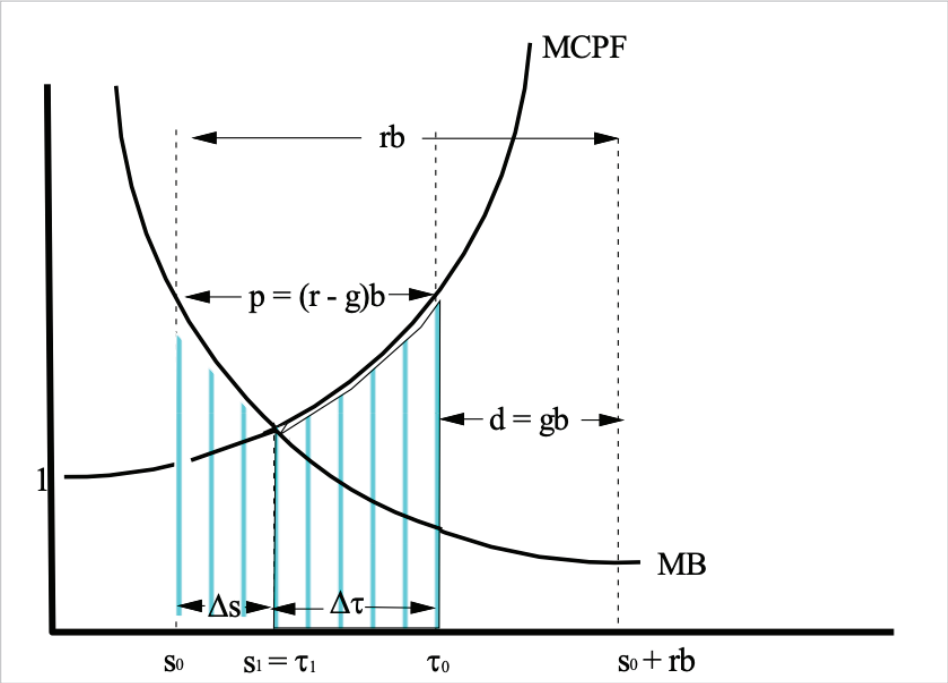
2. THE FISCAL COST OF THE PUBLIC DEBT

We begin with a simple model for evaluating the welfare loss that a society incurs because it has to finance interest payments on the public debt. This welfare loss occurs because the government has to run a primary budget surplus of $p = (r-g)b$, where r is the real interest rate on the debt, g is the growth rate of the economy and b is the public debt-to-GDP ratio.[1] It is assumed that the government chooses the optimal program spending rate where the benefit to its residents from an additional dollar spent on public services, MB, equals the loss sustained by taxpayers from raising an additional dollar of tax revenue, which is known as the marginal cost of public funds ($MCPF$). In Figure 1, the MB declines as program spending, s, increases, and the $MCPF$ increases as more tax revenue, τ, is raised. Given its required primary surplus of p, the optimal program spending, as a share of total output, is s_0, where MB equals $MCPF$ and the tax revenue ratio is τ_0. Maintaining a constant debt-to-output ratio also means that the government has to run a fiscal

[1] In this model, it is assumed that the real interest rate on the public debt exceeds the economy's growth rate, i.e., $r-g>0$, because otherwise households' well-being increases with the debt ratio, and the public debt ratio would increase without limit. Consequently, there is no equilibrium debt ratio in this model if $r-g<0$. As Laurin (2020) notes, when $r<g$, "there is a short-term political incentive for the government to 'stabilize' the debt ratio at a level as high as possible, because the higher the debt, the higher the ratio-stabilizing deficit (and the permanent size of the expenditure budget) in a growing economy."

deficit so that the debt increases at the economy's growth rate. The fiscal deficit ratio that stabilizes the debt ratio is $d = gb$.

Figure 1. The Burden of the Public Debt in a Growing Economy



Program spending, s, revenue, τ, interest payments rb and fiscal deficit, d as shares of output

In the absence of a public debt, the budget would be balanced with program spending increased to s_1 and tax revenue reduced to τ_1. The welfare loss from the public debt is the reduced program spending, Δs, and higher taxes, $\Delta \tau$, because the government has to run a primary balance surplus to finance its public debt. The welfare losses from the lower program spending and higher taxes are given by the shaded areas below the MB and $MCPF$ curves. In this setting, the MB and the $MCPF$ curves are functions of the primary balance p. The welfare loss from the reduction in program spending can be approximated by the area of the trapezoid under the MB curve or $WLS = 0.5(MB(p) + MB(0))\Delta s$. The welfare loss from the increase in the tax burden can be approximated by the area of the trapezoid under the $MCPF$ curve or $WLT = 0.5(MCPF(p)+MCPF(0))\Delta \tau$. We refer to these welfare losses as the fiscal cost of the public debt ($FCPD$). Combining these two measures of the welfare loss from lower program spending and higher taxes, and noting that $MB(p) = MCPF(p)$ and that $\Delta s + \Delta \tau = p$, the $FCPD$ can be approximated as:

$$FCPD = 0.5(MCPF(p)+MCPF(0))p \quad (1)$$

This expression shows the $FCPD$ is larger the higher the primary budget balance required to stabilize the public debt ratio. As well, since $MCPF(p) > MCPF(0) > 1$, we can infer that the $FCPD$ is greater than the primary budget balance required to stabilize the debt ratio.

Using the formula in (1) to approximate the $FCPD$ requires an estimate of how the $MCPF$ varies with a government's primary balance. Previous estimates of the $MCPF$ for the federal and provincial governments are based on the elasticity of revenues or tax bases with respect to

tax rates, not primary balances (Dahlby and Ferede 2018, 2022). Therefore, those estimates of the *MCPF* cannot be directly used to calculate the *FCPD* using equation (1).

Appendix 1 shows the derivation of a formula for the *FCPD* using a log-log utility function for a representative household based on consumption of private goods and public goods and services. That model yields the following expression for an indirect utility function for a representative household in terms of the primary budget balance, p, and income, Y:

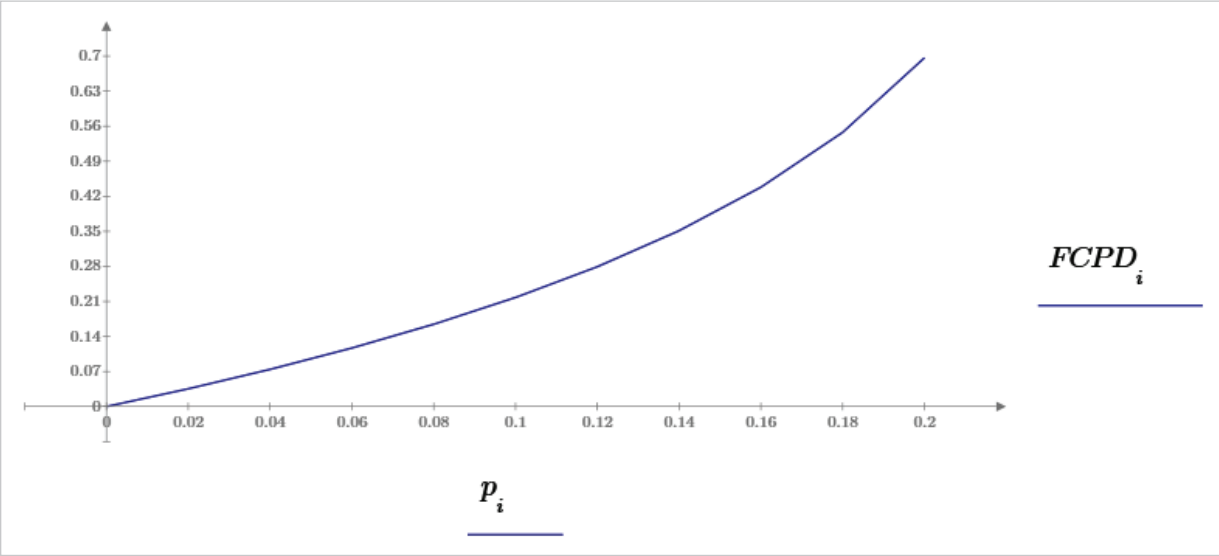
$$U = V(p,Y) = (\alpha+\gamma)\cdot ln(\alpha-p) + (1+\gamma)\cdot ln(Y) + C \tag{2}$$

where α can be interpreted as the contribution of the tax base to a representative household's well-being and γ which can be interpreted as program spending's contribution to the representative household's well-being and C is a constant. The marginal utility of income is $(1+\gamma)/Y$. Accordingly, the fiscal cost of the public debt, expressed as a proportion of aggregate income, is given by the following equation:

$$FCPD = \frac{V(0,Y)-V(p,Y)}{1+\gamma} = \frac{(\alpha+\gamma)\cdot(ln(\alpha)-ln(\alpha-p))}{1+\gamma} \tag{3}$$

The *FCPD* is increasing in γ and lower the larger α is, i.e., the broader the government's tax base, the lower the *FCPD*. As Figure 2 indicates, the *FCPD* increases, and increases at an increasing rate, as the primary balance increases.

Figure 2. The FCPD and the Primary Budget Balance



This also means that the *FCPD* increases at an increasing rate as the debt ratio increases. The convexity of the *FCPD* means that debt reduction reduces the burden from a major increase in the public debt during a recession and can be considered a form of fiscal insurance.

In order to calculate the *FCPD*, we need to derive values for α and γ from a government's fiscal choices. Since our model assumes fiscal policies that stabilize the debt-to-GDP ratio, we derive these parameter values based on the average values of the key fiscal variables for the federal

government in the 2010 to 2019 period.[2] During that period, the federal net debt ratio averaged 31.65 per cent, with a standard deviation of 2.56, and the interest-bearing debt ratio averaged 46.21, with a standard deviation of 1.92. The average federal program spending ratio was 13.52 per cent, interest payments on the public debt averaged 1.28 per cent and the average deficit ratio was 56 per cent. The weighted average of the federal $MCPF$ for the personal and corporate income taxes was 2.21 in 2015 (Dahlby and Ferede 2022). As shown in Appendix 1, the average values of these fiscal variables in the pre-pandemic period are consistent with α = 0.247 and γ = 0.298.

The federal government ran large deficits to finance pandemic-related spending in 2020 and 2021, and by 2023, the ratio of interest-bearing debt to GDP was 58.1 per cent, down from a high of 63.2 per cent (Government of Canada 2023b, vol. 1: 33). If the federal government stabilizes its debt ratio at its 2023 level, the required primary balance depends on the future $r-g$ differential. There has been much debate about whether real interest rates on government debt will return to pre-pandemic low levels or whether changes in international economic and fiscal conditions will result in higher rates. Similarly, there is much uncertainty about Canada's future growth rate, given the long-term slowdown in productivity growth and economic disruptions from geopolitical conflicts and international trade restrictions.

A recent paper by Heylen, Mareels and Van Langenhove (2024), hereafter HML, focuses on long-run structural factors that have influenced the $r-g$ differential in 17 OECD countries, including Canada, between 1981 and 2018. HML (2024, 8) found that productivity and employment growth, life expectancy and inequality have all been negatively associated with $r-g$.[3] With regard to fiscal variables, they found that a higher debt-to-GDP ratio was associated with a higher $r-g$ differential.[4] HML also found that an increase in the U.S.'s $r-g$ differential was associated with an increases in other countries' $r-g$ differentials.

HML (2024) use demographic, economic and fiscal variables forecasts by the International Monetary Fund, World Bank and OECD to project $r-g$ differentials for individual countries to 2040 under various scenarios concerning future fiscal policies and primary balances. For Canada, they project positive $r-g$ differentials from 2024 to 2040, with an average of 0.3744 per cent differential in their base case scenario.[5] While acknowledging that there is a great deal of uncertainty around this estimate, the HML projection is a good benchmark for calculating the $FCPD$ for the federal government.

With an average $r-g$ differential of 0.3744 per cent, the federal government would have to maintain a primary balance ratio of 0.21715 per cent in order to stabilize the current interest-bearing debt ratio at 58.1 per cent. From equation (3), in maintaining this primary balance and with α = 0.247 and γ = 0.298, the annual fiscal cost of the federal debt is 0.37 per cent of GDP or $10.7 billion. The model also indicates that the 12-percentage-point increase in the federal debt-to-GDP ratio resulting from federal borrowing to finance pandemic-related spending increased the annual burden of the debt by 0.1 per cent of GDP or $2.2 billion per year.

It is interesting to compare this estimate of the $FCPD$ with a conventional measure, real interest payments on the public debt ($RIPD$), at 0.67 per cent of GDP. For a given debt ratio, the $RIPD$ only depends on the real interest rates on the debt, while the $FCPD$ also varies with the economy's growth rate and values for α and γ that reflect the government's tax capacity and the marginal benefit

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2 Based on the Parliamentary Budget Officer (2023) report and data appendix.

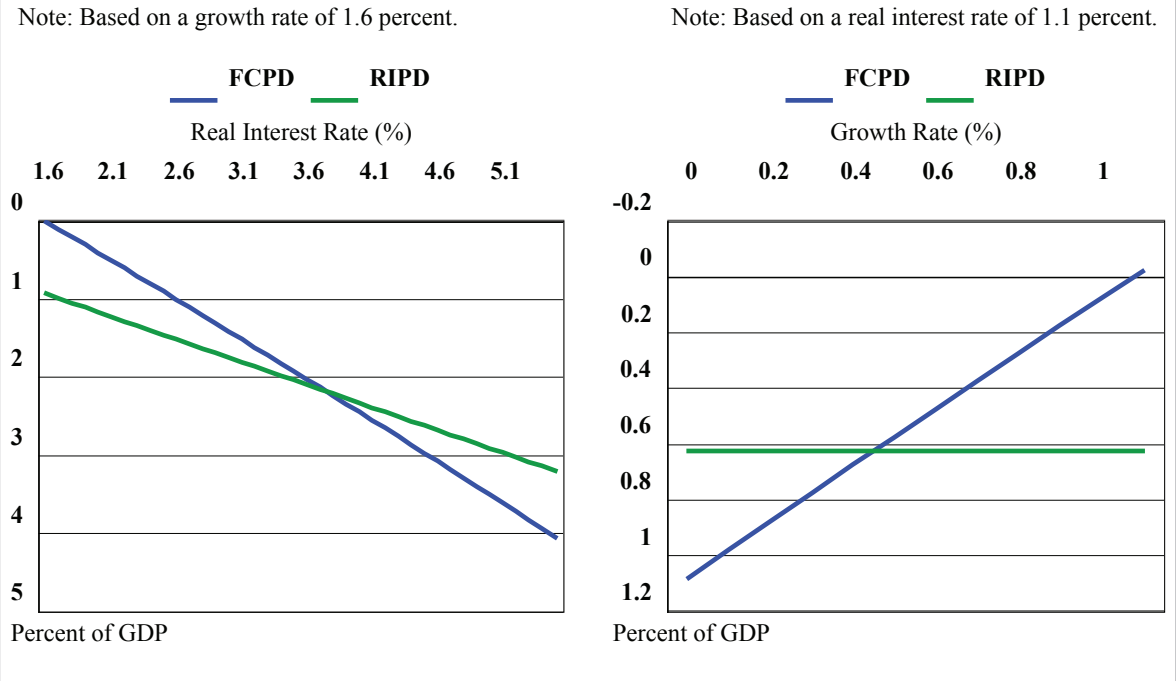
3 In HML's econometric model, the dependent variable was the nominal effective interest rate on government debt minus the nominal growth rate of GDP.

4 Checherita-Westphal and Domingues Semeano (2020) for euro-zone countries and Dahlby, Ferede and Fuss (2022) for Canada also found that the $r-g$ increases with the debt ratio.

5 After adjusting the nominal interest rate and GDP growth rate differential for two-per-cent inflation.

of program spending. Figure 3 shows that at a 58.1-per-cent debt ratio, the *FCPD* is less than *RIPD* if the real interest rate is less than 3.8 per cent and if the growth rate is greater than 0.4 per cent.

Figure 3. The FCPD vs. the RIPD



3. EVALUATING THE GAINS FROM REDUCING THE PUBLIC DEBT

The benefits from reducing the public debt can be broken down into four components. First, a lower public debt, holding interest rates and growth rates constant, lowers the *FCPD*. That is, a government's interest payments are lower, program spending can be higher and/or taxes lower in the future. Second, lower public debt ratios are associated with lower interest rates on the public debt, further reducing interest payments and the primary balance required to stabilize the debt ratio. Third, a considerable body of economic research shows that an economy's growth rate declines with the debt-to-GDP ratio. Dahlby and Ferede (2022) sum up the literature on this topic. To the extent that a lower debt ratio boosts the economy's growth rate, there is a direct benefit to households through higher incomes as well as an indirect benefit from lowering the primary budget balance required to stabilize the debt ratio. Finally, a lower public debt can provide fiscal insurance against future economic shocks, such as occurred during the financial crises of 2008–09 or the pandemic of 2020–21. During major recessions, governments can run large deficits as revenues decline and expenditures on employment insurance and other transfers increase, ratcheting up the public debt ratios. Having a lower debt ratio when a major downturn occurs reduces the burden of stabilizing the debt ratio in the post-recession period

Debt reduction requires a period of fiscal austerity[6] — lower program spending and higher tax burdens — so that program spending can be higher and/or taxes lower in the future. Fiscal austerity is therefore a classic example of short-term pain for long-term gain. Accordingly,

[6] We define fiscal austerity as the decision of a government that has a stabilized debt ratio to lower its debt ratio in order to distinguish it from the necessary fiscal adjustment that a government with an unsustainable fiscal policy and a rising debt ratio has to undertake sooner or later.

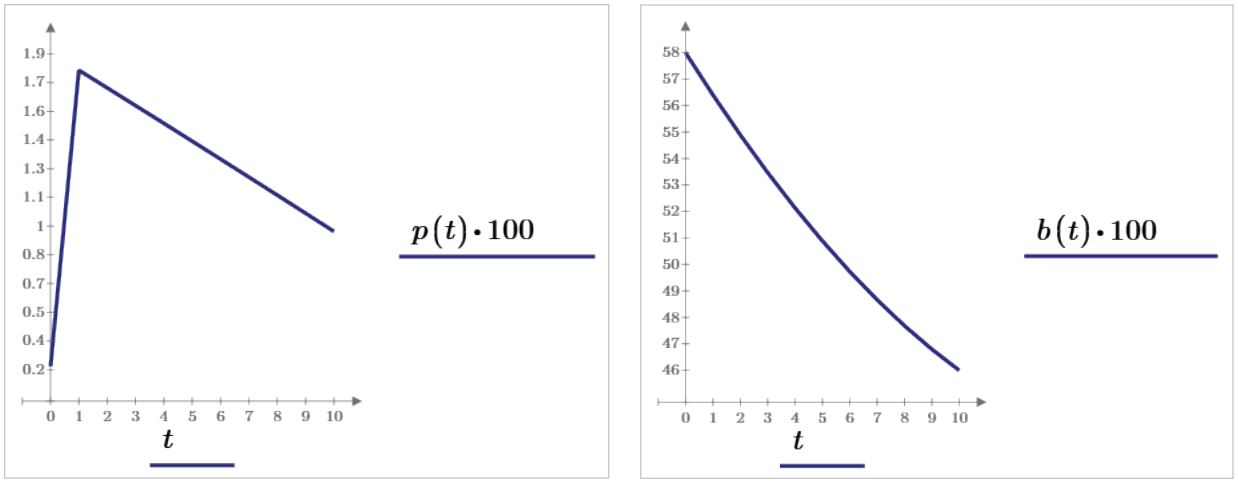
whether fiscal austerity passes a cost-benefit test depends not only on the future fiscal and economic benefits associated with lower debt, but also on how the public values those future gains relative to short-term losses. In economic models, evaluating this trade-off involves the use of a discount rate to value future gains or losses. Climate policy modelling has made the use of discount rates in evaluating public policies controversial. Some economists advocate for the use of very low or zero discount rates because of uncertainty about future climate impacts of greenhouse gases (GHGs) and ethical concerns about the impacts of climate change on future generations. Consequently, they recommend highly restrictive GHG emissions policies. Other economists argue for the use of discount rates that are consistent with current private-sector saving and investment decisions, leading to a lower social cost of carbon and slower rate of increase in carbon taxes.

3.1 OPTIMAL FISCAL AUSTERITY

The discount rate is important, not only for comparing current fiscal hardships with future fiscal and economic benefits, but also for determining the optimal fiscal adjustment during the period of fiscal restraint. Technical Appendix 2 describes the model that is used to generate the least costly, or most efficient, fiscal adjustment for achieving a reduction in the federal debt ratio from 58 per cent to its pre-pandemic average of 46 per cent. The optimal time paths for the debt ratio $b(t)$ and the primary budget surplus $p(t)$ are based on numerical solutions to a second order differential equation. Below, we consider three cases in which the federal debt ratio is reduced by 12 percentage points over a 10-year period. These cases illustrate how the optimal austerity policy depends on the difference between the discount rate, ρ, and $r - g$.

Figure 4 shows that with a zero discount rate the optimal fiscal austerity policy is an abrupt increase in the primary budget surplus from 0.2172 per cent to 1.764 per cent in the first year and then a gradual reduction in the primary surplus to 0.922 per cent in year 10. This policy results in a rapid decline in the debt ratio from 58 per cent to 51 per cent in year five before hitting the target debt ratio of 46 in year 10.

Figure 4. Case 1: The Time Paths for the Primary Budget Balance and the Debt Ratio with a Zero Discount Rate



In Case 2, shown in Figure 5, we assume $\rho = r - g$. In year 1, the primary budget surplus increases from 0.2172 per cent to 1.395 per cent and is maintained at that level over the rest of the austerity period. As a result, the debt ratio declines at a constant rate of 1.2 percentage points per year until a target debt ratio of 46 per cent is achieved in year 10.

Figure 5. Case 2: The Time Paths for Primary Budget Balance and the Debt Ratio with a Discount Rate Equal to r - g

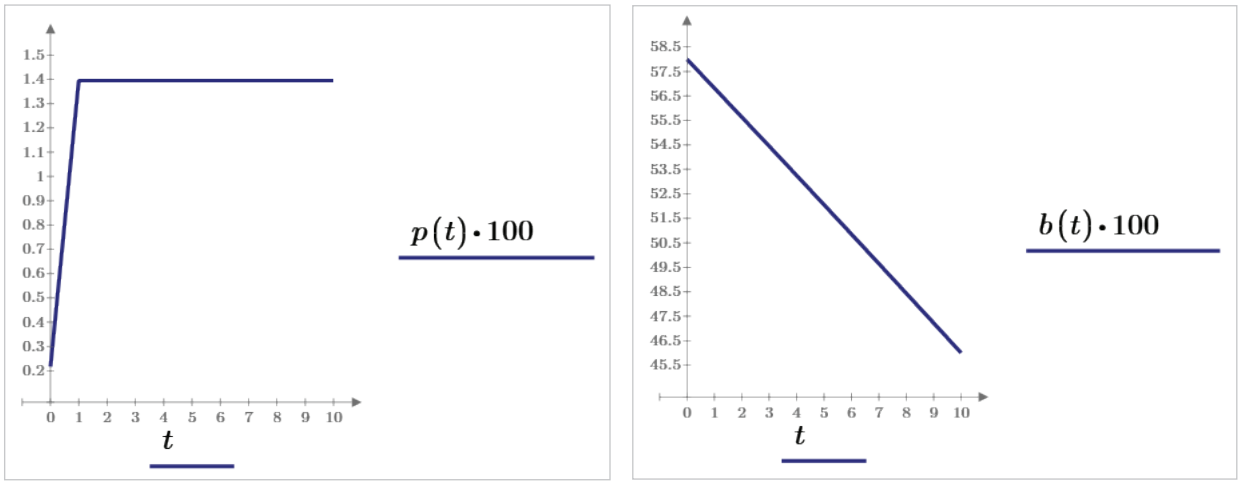
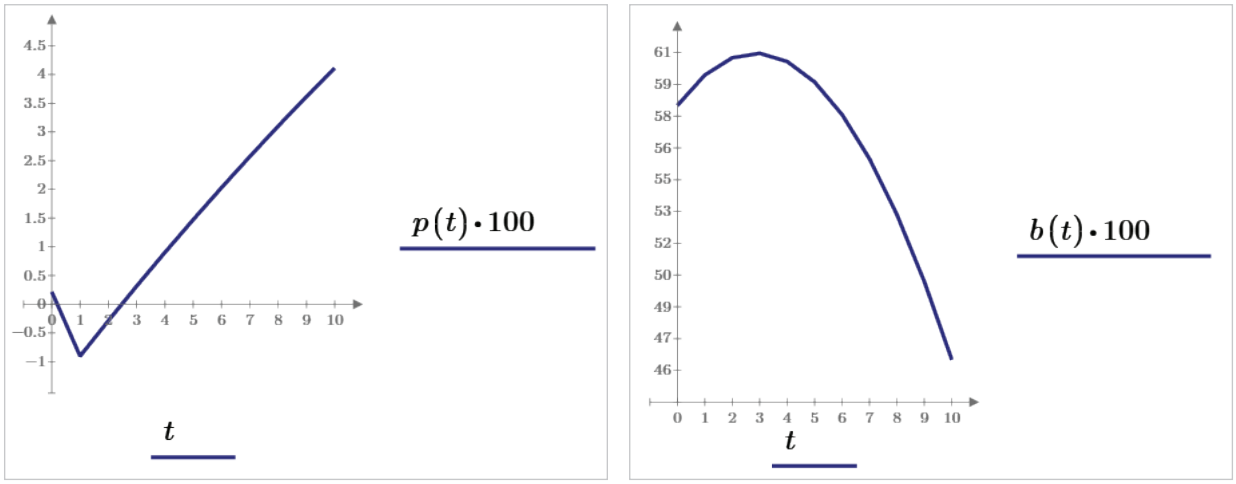


Figure 6. Case 3: The Time Paths for the Primary Budget Balance and the Debt Ratio with a Discount Rate of 3 Per Cent



In Case 3, a three-per-cent discount rate is assumed with $\rho > r - g$. As shown in Figure 6, the primary balance is reduced -0.903 per cent in year one and to -0.2854 per cent in year two. Accordingly, the debt ratio increases and is still higher than its initial level in year five. In other words, with a three-per-cent discount rate, the fiscal adjustment is not just postponed — it is reversed. This means that to hit the target debt level in year 10, the primary surplus has to steadily increase after the initial cuts to 4.1157 per cent in year 10.

These three cases show that the gap between the discount rate ρ and $r - g$ plays a key role in determining the timing and magnitude of the increases in the primary budget surpluses that are required to achieve a given reduction in the debt ratio over a fixed period of time.

3.2 DECOMPOSING THE NET GAIN FROM FISCAL AUSTERITY AND DEBT REDUCTION

Technical Appendix 3 contains a detailed description of the model that was used to simulate the net gain from reducing the federal debt-to-GDP ratio from 58 per cent to 46 per cent over 10 years. Since 1980, the Canadian economy has been subject to four recession shocks —1982, 1991, 2009 and 2020 — in which real GDP declined by, on average, 3.0 per cent. These recession shocks have occurred roughly once every 10 years over the past 40 years. (Importantly, we do not observe any offsetting large positive shocks to the growth rate). During these economic downturns, the federal government's debt has increased as revenues declined and some expenditures, such as employment insurance, increased. In the future, there will be recession shocks that will increase budget deficits and ratchet up the public debt. Although it is impossible to forecast the size and timing of future economic downturns, the experiences of the past 40 years provide some indication of the frequency of recessions and their impact on governments' finances.

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. To measure the potential gains from reducing these fiscal risks, we have adapted the Monte Carlo simulation models in Dahlby and Ferede (2023, 2024) 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 calculation of the net gain from debt reduction is based on the present values of a representative household's utility with and without fiscal austerity. To get an appreciation of how much each of the four components contributes to the net gain from debt reduction, we start by first calculating the net gain from the reduction in the debt ratio, without interest rate effects, growth rate effects or growth rate shocks. The second column in Table 1 shows that simply lowering the federal debt ratio by 12 percentage points over 10 years would result in a welfare loss using discount rates ranging from zero to five per cent. (It is important to note that different discount rates used in these calculations also reflect different fiscal policies to achieve the debt reduction over 10 years, with higher discount rates leading to more back-loading of the fiscal adjustment).

Table 1. Expected Present Values of the Net Gain from Debt Reduction (Per cent of GDP)

Discount Rate (Per cent)	Lower Interest Payments	With Interest Rate Effects	With Growth Rate Effects	With Random Growth Rate Shocks	Probability of a Net Gain (Per Cent)
0.00	-13.7	-0.5	52.7	189.4	77
1.00	-17.3	-7.5	30.4	93.3	73
2.00	-19.2	-11.7	16.0	44.9	69
3.00	-20.0	-14.1	6.5	19.2	65
4.00	-21.0	-15.4	0.1	4.8	58
5.00	-19.8	-15.9	-4.2	-3.5	53

The third column shows that debt reduction still has a negative impact on welfare when we incorporate the effects of lowering the debt ratio on interest rates on the public debt. The fourth column shows that adding the growth rate effects of lowering the debt ratio has a large and positive effect on welfare. There is a positive net gain if the discount rate is four per cent or less.

To this point, the net gains from lowering the public debt have been evaluated in the context of a stable economy. The fifth column shows the expected net gain from debt reduction when random growth rate shocks are added to the model. The fiscal insurance aspect of debt reduction adds to the gains from debt reduction, although there is still a welfare loss if a five-percentage-point discount rate is used to evaluate fiscal policies. For discount rates less than five per cent, there are substantial net gains from debt reduction. For example, there is an expected net gain equal to 19.2 per cent of GDP with a discount rate of three per cent with a 65-per-cent probability of a net gain. Overall, the model indicates that the net gains from debt reduction are substantial with discount rates of four per cent or less and that the largest sources of the gains are from fiscal insurance and the growth rate effects from lowering the debt ratio.

4. CONCLUDING REMARKS

We began this paper by asking: Is reducing the public debt worthwhile? The starting point of our analysis is a measure of the fiscal cost of the public debt, i.e., the welfare loss from lower program spending and/or higher taxes in financing interest payments on the public debt. The fiscal cost of the public debt depends on the marginal cost of public funds, which measures the opportunity cost of lower taxes or high program spending, the debt ratio and the difference between the real rate of interest and the economy's growth rate. This measure differs from the conventional measures of the burden of the public debt — interest payments on the public debt as a share of tax revenue or GDP — because it depends on the cost of raising tax revenues and the economy's growth rate. Both are important. The burden of the public debt is higher the more distortionary are the taxes that have to be imposed to finance the interest payments. And the faster the economy's growth rate, the smaller the primary surplus required to stabilize the debt ratio and the lower the burden of public debt.

In addition to lowering the fiscal cost of the public debt, a lower public debt is associated with lower interest rates, positive impacts on economic growth and a reduction in the fiscal burden from abrupt increases in public debt following major adverse economic shocks, such as occurred during the financial crises of 2008–09 or pandemic of 2020–21.

The answer to our question hinges on the discount rate that a society uses to evaluate the future benefits of a lower public debt. Our model indicates that reducing the federal debt by 12 percentage points over 10 years would pass a cost-benefit test if a discount rate of four per cent or less is used to evaluate the future benefits. The present value of the net gains from debt reduction are substantial with the largest source of gains from fiscal insurance and growth rate effects.

As with all fiscal policy decisions, it is important to consider the distributional effects of fiscal austerity and debt reduction. The representative household model used in this paper does not provide a framework for evaluating distributional effects, but a few brief comments are in order. Whether fiscal austerity adversely affects low-income groups will depend on which spending programs are constrained or cut, or which taxes are raised. In the post-austerity period, the main beneficiaries from a lower debt will be the younger cohorts who will benefit from increased spending and/or lower taxes in the future. Measuring these distributional effects is important in evaluating fiscal austerity and debt reduction but are beyond the scope of this paper.

TECHNICAL APPENDIX 1: A MODEL FOR CALCULATING THE FISCAL COST OF PUBLIC DEBT

We adapt a model in Dahlby (2011, 315), which dealt with the fiscal responses of governments in receipt of a lump-sum grant, to model the equivalent although opposite effects that interest payments on public debt have on optimal fiscal decisions. The model is based on the following utility function for a representative household:

$$U=\alpha\cdot ln\left(X_1\right)+\beta\cdot ln\left(X_2\right)+\gamma\cdot ln\left(S\right)\quad \alpha+\beta=1\quad 0<\alpha<1\quad \gamma>0 \tag{A1}$$

where X_1 and X_2 are private consumer goods and S is the expenditure on a publicly provided good or service. The government levies a per-unit tax of τ on X_1 to finance its expenditure on S which raises the price of X_1 to $1+\tau$. The resource constraint for the economy is:

$$X_1+X_2+S+r\cdot B=Y$$

where r is the real interest rate on the public debt, B, and Y is aggregate income which is assumed to be exogenous. The public debt is assumed to be held by foreigners and the interest payments on the public debt represent a claim on aggregate income. The representative household maximizes utility by allocating its fixed income Y between the two private goods, given the price of X_1 and given S such that:

$$X_1=\frac{\alpha\cdot Y}{1+\tau}\qquad X_2=\beta\cdot Y$$

The government's budget constraint is:

$$S+r\cdot B=\frac{\tau}{1+\tau}\cdot\alpha\cdot Y$$

It can be shown that MB and the $MCPF$ take the following simple forms:

$$MB=\gamma\cdot\frac{Y}{S}\qquad MCPF=1+\tau$$

With the optimal tax and expenditure policy, $MB = MCPF$ and we have the following reduced form equations:

$$MCPF=\frac{\alpha+\gamma}{\alpha-r\cdot b}\qquad s=\frac{\gamma}{\alpha+\gamma}\cdot\left(\alpha-r\cdot b\right)$$

where $b = B/Y$ and $s = S/Y$. Note that $\alpha - rb > 0$ because interest payments on the debt cannot exceed the tax base. Interest payments on the public debt, rb, raise the marginal cost of public funds, which crowds out some public program spending. An additional percentage point of interest payments as a share of aggregate output reduces program spending by $\gamma/(\alpha+\gamma)$ per cent.

It is straightforward to incorporate the aggregate output growth rate, g, in the model because the ratios of X_1, X_2 and S to Y are independent of Y. With all variables expressed as shares of output, the resource constraint for the economy, is equal to:

$$x_1 + x_2 + s + r \cdot b = 1 + d$$

where d is the fiscal deficit ratio, with $d = gb$. It is assumed that the debt ratio is stabilized with a primary surplus of $p = (r - g)b$ and x_1 and s can be expressed as a function of p:

$$x_1 = \frac{\alpha}{\alpha + \gamma} \cdot (\alpha - p) \qquad s = \frac{\gamma}{\alpha + \gamma} \cdot (\alpha - p)$$

As explained in the text, we use values of the key fiscal variables from the 2010 to 2019 period to derive α and γ from two equations:

$$MCPF = \frac{\alpha + \gamma}{\alpha - r \cdot b + d} \qquad s = \frac{\gamma}{\alpha + \gamma} \cdot (\alpha - r \cdot b + d)$$

As noted in the text, we use $MCPF$ = 2.21, s = 0.1352, b = 0.4621 and d = 0.0056. The average rate of increase in the GDP deflator in 2010 to 2019 was i = 0.0156. Average nominal interest payments on interest-bearing debt, vb = 0.01277, are converted to real interest payments on interest-bearing debt: $rb = (vb - ib)/(1 + i)$ = 0.0055. The solution to the above equations with these values of the fiscal variables yields α = 0.247 and γ = 0.298.

Substituting the above into (A1) and with $x_2 = \beta$, the household's utility level can now be expressed as a function of the primary balance:

$$U = V(p, Y) = (\alpha + \gamma) \cdot ln(\alpha - p) + (1 + \gamma) \cdot ln(Y) + C$$

where C is a constant. The marginal utility of income is $(1 + \gamma)/Y$. Accordingly, the fiscal cost of the public debt, $FCPD$, expressed as a proportion of aggregate income is given by the following function:

$$FCPD = \frac{V(0, Y) - V(p, Y)}{1 + \gamma} = \frac{(\alpha + \gamma) \cdot (ln(\alpha) - ln(\alpha - p))}{1 + \gamma}$$

TECHNICAL APPENDIX 2.
A MODEL OF OPTIMAL FISCAL AUSTERITY

We assume that the debt ratio is initially stabilized at $b(0)$, with a primary surplus of $p(0) = (r-g)b(0)$ and that the government wishes to reduce the debt ratio to $b(T)$ in year T. Debt reduction therefore requires an increase in the primary surplus over some time interval resulting in lower program spending and/or higher taxes, i.e., a period of fiscal austerity. We want to determine the least costly sequence of primary surpluses that achieves the desired debt reduction. Accordingly, we use the following dynamic optimization model:

$$\text{Max } V = \int_0^T U(p(t)) \cdot e^{-\rho \cdot t} \, dt \text{ subject to: } b'(t) = \eta \cdot b(t) - p(t)$$

where $p(t)$ is the control variables, ρ is the representative household's discount rate, $b(t)$ is the state variable and $\eta = (r-g)$ which is assumed to be constant. The current value Hamiltonian is:

$$Hc = (\alpha+\gamma) \cdot ln(\alpha - p) + \lambda \cdot (\eta \cdot b - p)$$

and the first order conditions are:

$$\frac{\partial}{\partial p} Hc = -1 \cdot \frac{(\alpha+\gamma)}{(\alpha-p)} - \lambda = 0 \text{ or } p(t) = \alpha + \frac{(\alpha+\gamma)}{\lambda(t)}$$

and

$$\lambda'(t) - \rho \cdot \lambda(t) = -\left(\frac{\partial}{\partial b} Hc\right) = -1 \cdot \lambda(t) \cdot \eta \text{ or } \lambda'(t) + (\eta - \rho) \cdot \lambda(t) = 0$$

Therefore

$$\lambda(t) = k \cdot e^{(\rho-\eta)\cdot t} \text{ and } p(t) = \alpha + (\alpha+\gamma) \cdot k \cdot e^{(\eta-\rho)\cdot t}$$

where k is a constant such that:

$$p(0) = \eta \cdot b(0) \quad \eta \cdot b(0) = \alpha + (\alpha+\gamma) \cdot k \quad k = \frac{\eta \cdot b(0) - \alpha}{\alpha+\gamma}$$

And therefore:

$$b'(t) = \eta \cdot b(t) - \left(\alpha + (\alpha+\gamma) \cdot k \cdot e^{(\eta-\rho)\cdot t}\right)$$

To find the optimal path for $b(t)$ from $b(0)$ to $b(T)$, we need to solve the following second order differential equation:

$$b''(t) - \eta \cdot b'(t) + (\alpha+\gamma) \cdot (\eta - \rho) \cdot k \cdot e^{(\eta-\rho)\cdot t} = 0$$

As we have been unable to find an analytical solution to the above equation, we have used Mathcad's ODEsolve program to find numerical solutions given the model's parameters. The solutions to this equation are shown in Figures 4, 5 and 6 for $\rho = 0$, $\rho = \eta$ and $\rho = 0.03$ respectively.

TECHNICAL APPENDIX 3.
A MODEL FOR EVALUATING DEBT REDUCTION

The model evaluates the four components of the gains from debt reduction. Three of the four components — the gains from lower interest payments, lower interest rates and faster growth rates — were calculated in the absence of economic shocks. To calculate the gain from fiscal insurance, we used a version of the model that incorporates fluctuations in the annual growth rate due to recession shocks and to 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. We approximate the normal shocks as a normal distribution with mean zero and a standard deviation of 1.32 per cent. The recession shocks were calculated as the average difference between the (negative) growth rate in the recession year and the average annual growth rate in the recent non-recession years, -6.13 per cent. The probability of a recession shock in any year is 0.0805. Dahlby and Ferede (2023) explain in greater detail how the shocks were modelled.

The equations of the model are shown below:

$$\begin{bmatrix} p_{t+2} \\ b_{t+2} \\ r_{t+2} \\ g_{t+2} \\ Y_{t+2} \end{bmatrix} = \begin{bmatrix} \left(r_{t+1} - g_{t+1}\right) \cdot b_{t+1} + I \cdot \delta \cdot z_{t+1} \\ \dfrac{\left(1 + r_{t+1}\right) \cdot b_{t+1} - p_{t+1}}{\left(1 + g_{t+1}\right)} \\ \rho 0 + \rho 1 \cdot b_{t+1} + \rho 2 \cdot g_{t+1} \\ \gamma 0 + \gamma 1 \cdot \left(ln\left(b_{t+1}\right) - ln\left(b_t\right)\right) + I \cdot z_{t+1} \\ \left(1 + g_{t+1} + I \cdot z_t\right) \cdot Y_{t+1} \end{bmatrix}$$

In the first equation, z_t is the random growth rate shock in year t, I is an indicator variable set equal to one or 0 to evaluate the gains from debt reduction with or without growth rate shocks and δ = 0.545 is a parameter estimate from Dahlby and Ferede (2023) of the effects of growth rate shocks on the federal primary budget balance. It is assumed that in the absence of an economic shock, the primary balance would stabilize the debt at its current level. The second equation is a standard debt-dynamics relationship. The parameters in the third equation are based on Dahlby and Ferede's (2023) estimate of the effects of the debt ratio and the growth rate on the real interest rate on government debt. In simulations with interest rate effects, $\rho 1$ = 0.051, $\rho 2$ = 0.367 and $\rho 0 = r0 - \rho 1 b0 - \rho 2 g0$, where r_0 = 0.019744, b_0 = 0.58 and g_0 = 0.0160. In the simulations without interest rate effects, ρ1 = 0 and ρ2 = 0. The fourth equation reflects the Dahlby and Ferede (2023) estimate that the growth rate depends on the rate of increase in the debt ratio, not its level, with $\gamma 0 = g0$ and $\gamma 1$ = -0.074. In the simulations without growth rate effects, $\gamma 1$ = 0. The fifth equation shows how real aggregate income evolves, with or without growth rate shocks.

In the simulations without growth rate shocks, we calculate the representation household's utility with fiscal austerity, VFA, and without fiscal austerity, VSQ, based on the indirect utility functions:

$$VFA_t := (\alpha+\gamma)\cdot\ln\left(\alpha-pfa_t\right)+(1+\gamma)\cdot\ln\left(Yfa_t\right)+C$$

$$VSQ_t := (\alpha+\gamma)\cdot\ln\left(\alpha-p_t\right)+(1+\gamma)\cdot\ln\left(Y_t\right)+C$$

p_t is the primary balance required to maintain the status quo debt ratio, b_0 = 0.58 and pfa_t is the primary budget balance under a fiscal policy that reduces the debt ratio from 0.58 to 0.46 over 10 years. The time profile of the primary budget balance with debt reduction depends on the discount rate, with more back-loading of the fiscal adjustment the higher the discount rate. We used discount rates from zero to five per cent to determine the time paths for the primary budget balances based on the model of optimal fiscal austerity in Technical Appendix 2.

To calculate the gain or loss from reducing the debt ratio by 12 percentage points over 10 years, we calculated the present value of a representative household's utility over 100 years:

$$PVFA = \sum_{t=0}^{100}\frac{VFA_t}{(1+v)^t}$$

$$PVSQ = \sum_{t=0}^{100}\frac{VSQ_t}{(1+v)^t}$$

The net gain as a share of aggregate income from reducing the debt ratio was then defined as the difference in the present values of the utilities divided by the marginal utility of income in the model or:

$$Gain = \frac{PVFA-PVSQ}{1+\gamma}$$

To calculate the fiscal insurance gain, we generated 250 episodes with the random (normal and recession) shocks to the growth rate over 100 years. We then calculated the average or expected gains from the debt-reduction policies over each of these 250 episodes.[7]

[7] Monte Carlo simulation models often use 1,000 or more episodes to derive estimates of the probability distribution of the modelled variables. In the present case, the basic results converged with 250 episodes or 25,000 year-episodes. For each of the 250 episodes, there are seven different time profiles for the primary balances for each of the 10-year-long episodes.

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