An Examination of Alternative Strategies for Reducing Public Debt in the Presence of Uncertainty

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– Abstract –

The *Debt Repayment Plan* introduced in the 1998 federal budget aims to keep the federal debt-to-GDP ratio on a "clear, downward profile". This paper examines alternative strategies for implementing such an objective.

The analysis is undertaken within a stochastic simulation framework. The fiscal authority seeks to keep the debt-to-GDP ratio within a range that declines gradually over time in the presence of uncertainty about future economic and fiscal developments. We find that a medium-term fiscal planning strategy that focuses exclusively on the budget balance would require a fairly wide target range. Our estimates indicate that the debt-to-GDP ratio would have a 90 per cent confidence interval in the range of about 7 to 12 percentage points at the ten-year planning horizon. In contrast, a strategy that aims to return the debt-to-GDP ratio to its desired level in each coming fiscal year would provide a tight degree of debt control. However, such a strategy would require large and frequent discretionary changes to program spending and/or taxes and result in a pro-cyclical fiscal policy stance.

As a compromise, we consider a medium-term planning strategy that aims to return the debt-to-GDP ratio to its desired level in a gradual manner. Our simulation results indicate that such a strategy could provide a moderate amount of debt control without a pro-cyclical policy stance or excessive discretionary changes. While considerably more work would be required to make it operational, this general strategy would provide the fiscal authority with the ability to trade-off its conflicting policy objectives.

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1. Introduction

Now that the federal deficit has been eliminated in Canada, attention has shifted to reducing the debt burden. The 1998 federal budget introduced the *Debt Repayment Plan,* which aims to keep the federal debt-to-GDP ratio on a clear, downward profile.[1] The debt-to-GDP ratio peaked at 71.2 per cent in 1995-96 and is expected to decline to about 58.9 per cent in 1999-2000 and continue to fall to about 40 per cent by 2005-06.

In pursuing this objective, the fiscal authority faces complications that arise from the inherent uncertainty about future economic and fiscal developments. Uncertainty is currently taken into account by incorporating an explicit level of “prudence” into the fiscal plan and keeping to a two-year planning horizon. The current fiscal planning procedure sets aside a $3 billion Contingency Reserve allocated to reduce the federal debt every year, unless needed for unanticipated economic developments. This is supplemented by an extra degree of economic prudence, currently set at $1 billion for the coming fiscal year and $2 billion for the subsequent fiscal year. The Contingency Reserve together with the added “prudence factors” provide insurance against the risk of a deficit outcome in the event that economic conditions turn out to be significantly weaker than anticipated.

A number of existing studies have applied stochastic simulation methods to examine how much “fiscal prudence” would be required to insure against the risk of running a deficit. Boothe and Reid (1998) examine the case where the fiscal authority seeks to balance the budget, on average, over a number of years. Their simulation results indicate that a contingency reserve of between $6 and $9 billion would be sufficient to avoid a deficit outcome with 90 per cent probability over a budget period of two to four years. Robson and Scarth (1999) examine the case where the fiscal authority plans a budget surplus equal to one per cent of GDP each fiscal year (which is currently about $10 billion). Their simulations indicate that aiming for a surplus of this magnitude would entail a negligible risk of running a deficit. Hermanutz and Matier (2000) examine a

[1] Unless otherwise noted, the “debt/GDP ratio” refers to *net federal public* debt as a proportion of GDP.

fiscal planning framework characterized by rolling two-year budget plans . They find that a prudence level of $3.3 billion in the first year and $7.2 billion in the second year would provide insurance against a deficit outcome with 90 per cent probability in each year. Dalsgaard and De Serres (1999) examine how member countries of the European Monetary Union (EMU) can avoid running budget deficits in excess of 3 per cent of GDP as specified in *The Stability and Growth Pact*. Their simulation results show that that aiming for a cyclically-adjusted budget deficit of between 1.0 and 1.5 per cent of GDP would achieve this objective with 90 per cent confidence. This implies a level of prudence for the cyclically-adjusted budget balance of between 1.5 and 2.0 per cent of GDP.

The studies mentioned above focus on how uncertainty influences the budget balance, but not the level of debt or the debt-to-GDP ratio. Fiscal planning strategies that aim to avoid budget deficits implies that the level of debt (and hence, the debt-to-GDP ratio) will decline over time. This is consistent with the objective of keeping the debt-to-GDP ratio on a clear, downward trend. Our paper examines alternative strategies. We examine the possibility of keeping the debt-to-GDP ratio within a specified range that declines gradually over time.

This paper has two primary objectives. The first is to measure the range in which the fiscal authority could expect to control fluctuations in the debt-to-GDP ratio. The second is to investigate the implications of controlling fluctuations in the debt-to-GDP ratio for other fiscal policy objectives.

The plan of the paper is as follows. The next section of the paper discusses how alternative strategies for debt control can be evaluated. Here we discuss the objectives of fiscal policy and propose a few simple policy rules that can be implemented to attain these objectives in a stochastic simulation framework. Section 3 briefly outlines the stochastic simulation methodology underlying our analysis and reports the simulation results. We conclude by summarizing our main findings and highlighting a few avenues for future research.

2. Evaluating Debt Reduction Strategies

We assume that the fiscal authority in our analysis seeks to limit fluctuations in the debt-to-GDP ratio relative to a benchmark profile that declines gradually over time. When economic growth turns out to be much weaker than anticipated, the debt-to-GDP ratio rises above its benchmark level. The fiscal authority is then faced with the decision of how to adjust program spending and/or taxes in order to reduce the debt-to-GDP ratio. We consider the case where the fiscal authority is equally concerned with deviations in the debt-to-GDP ratio above and below the benchmark profile. This implies that the debt control objective is symmetric.[2]

The symmetric nature of the debt control objective explored in this paper can be interpreted in a number of ways. One interpretation is that if the benchmark debt reduction profile were based on intergenerational equity considerations, a substantial decline in the debt-to-GDP ratio below the desired level would imply a decrease in intergenerational equity. It could also represent an opportunity to reduce the tax burden and/or increase program spending with a low risk of having to “backtrack” on announced measures if economic developments turn out to be substantially weaker than anticipated. It is important to keep in mind that an increase in the debt-to-GDP ratio does not necessarily entail a budget deficit.[3] “Planned” budget deficits are rare in our simulation experiments. Budget deficits occur *ex post* when economic growth turns out to be weaker than anticipated and debt service costs are higher than anticipated. It is also important to recognize that raising the debt-to-GDP ratio relative to the benchmark profile entails moving the budget balance toward a deficit position, but not necessarily running a budget deficit. In other words, when the debt-to-GDP ratio is below the benchmark profile the fiscal authority plans smaller budget surpluses to bring it back into line.

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[2] A companion paper by Patrick Georges (2001) considers the case where the fiscal authority has an asymmetric debt control objective and seeks to keep the debt-to-GDP ratio below a ceiling.

[3] The debt-to-GDP ratio increases when that the level of debt grows at a more rapid rate than GDP.

If debt reduction were the only objective of fiscal policy, program spending and taxes could be adjusted in each budget to keep the projected debt-to-GDP ratio at the desired level over the coming year. However, this would require large and frequent discretionary changes to program spending and/or taxes and also result in a *pro-cyclical* fiscal policy stance. The fiscal authority in our analysis wants to carry out announced tax and spending measures even if economic conditions turn out to be significantly weaker than anticipated. Large and frequent discretionary changes run the risk of having to "backtrack" on announced program spending and tax measures. The fiscal authority also wants to provide economic stabilisation by introducing discretionary changes to taxes and program spending in a counter-cyclical manner. The fiscal authority, therefore, faces a fundamental conflict between its debt control objective and its other objectives; namely, "policy smoothing" and economic stabilisation. Let us elaborate on these objectives.

Fiscal Policy Objectives

Debt Control

The fiscal authority in our analysis initially determines a *benchmark profile* for the debt-to-GDP ratio that declines gradually over time. It then seeks to minimize stochastic fluctuations in the debt-to-GDP ratio relative to the *benchmark profile*. The stochastic fluctuations are generated by random shocks in our stochastic simulation framework. We measure the degree of debt control attained by calculating 90 per cent confidence intervals for the simulated debt-to-GDP ratio.

The debt control objective has important implications for the credibility of the debt reduction plan. If the fiscal authority demonstrates that it can keep the debt-to-GDP ratio close to the announced profile most of the time, individuals will come to believe that the debt reduction plan will be successful and adjust their expectations accordingly. The fiscal agent can therefore enhance its credibility by pursuing a policy rule that attains a high degree of debt control. This should enhance its ability to undertake counter-cyclical policies when needed without losing credibility.

Our interpretation of credibility is significantly different from that implicit in the previous studies listed above. In particular, Robson and Scarth (1999) equate credibility to avoiding a deficit outcome in the event of unfavourable shocks.[4] The underlying intuition is that individuals would interpret a deficit outcome as a signal that the fiscal authority is either unwilling or unable to carry out its debt reduction plans. Although it seems quite plausible that the fiscal authority could lose credibility after reporting a series of large budget deficits, it is unclear that a small deficit outcome would have an important effect on expectations. By failing to take into account the magnitude of the budget balance, this definition of credibility greatly exaggerates the consequences of a small deficit versus a small surplus outcome.

Furthermore, it is important to recognize that the risk of running a budget deficit depends on the debt reduction path. In a steady state characterised by a constant (positive) debt-to-GDP ratio, the budget balance will eventually move into a deficit position.[5] At this point in the debt reduction process, the fiscal authority will begin to run budget deficits permanently (on average). Thus, a series of sizeable budget deficits would have important implications for credibility in the early stage of the debt reduction plan but the implications will diminish over time as the debt-to-GDP ratio declines.

"Policy Smoothing"

The fiscal authority in our analysis wants to carry out announced tax and spending measures even if economic conditions turn out to be significantly weaker than anticipated. Discretionary changes to program spending and/or taxes would be required during a period of weak economic growth in order to contain the rise in the debt-to-GDP ratio above the *benchmark profile*. This could make it difficult for the fiscal authority to maintain its commitment to previously announced tax and spending measures.

An unanticipated severe recession would require hard fiscal choices. The fiscal authority would have to cut program spending and/or raise taxes in order to reduce the

[4] Most of the other studies simply calculate how much fiscal prudence is needed to ensure that a deficit does not occur. Presumably, the government would want to know this because it was concerned that running any deficit would damage its credibility.

[5] In steady state, the level of debt will grow at the same rate as GDP in order to keep the debt/GDP ratio constant, implying a budget deficit indefinitely.

risk of a deficit outcome. Each of these policy options has undesirable consequences. For example, cutting federal transfers to persons would inhibit the consumption-smoothing benefit of stable tax-transfer system (particularly in the presence of binding liquidity constraints at the household level). Making large transitory changes to direct program spending can also be very costly, particularly if this entails abolishing existing programs and then subsequently setting up new programs. Similarly, the fiscal authority wants to avoid making large transitory changes to tax rates in order to minimize tax distortions (as in Barro 1979).

We gauge the fiscal authority's ability to provide "policy smoothing" in the stochastic simulation framework by calculating the amount of variation of discretionary spending.[6] Higher variation in discretionary spending increases the risk that the fiscal authority would have to "backtrack" on its commitment to provide announced tax and spending measures. In other words, fiscal planning strategies that require less variation in discretionary spending will enable the fiscal authority to carry out announced tax and spending measures and maintain the debt reduction initiative at the same time.

Economic Stabilisation

The stabilisation role of fiscal policy has a long tradition in macroeconomics, dating back to Keynes' *The General Theory of Employment, Interest, and Money* (1936). The fiscal authority seeks to dampen business cyclical fluctuations by implementing a *counter-cyclical* overall policy stance. This entails moving the budget balance toward a surplus (deficit) position during expansionary (contractionary) periods. This is achieved in part through various spending programs and aspects of the tax system that are designed to provide automatic stabilisation. Discretionary changes can also be made to supplement automatic stabilisation, providing a more *counter-cyclical* overall policy stance. A counter-cyclical policy stance would, however, conflict with efforts to control the debt-to-GDP ratio.

[6] For presentation purposes, we refer to discretionary changes to program spending and/or taxes as "discretionary spending". There is no distinction between discretionary changes to program spending and taxes in the model used.

Consider what would happen if the economy suddenly went into a severe recession and the debt-to-GDP ratio rose significantly above the *benchmark profile*. Discretionary changes to program spending and/or taxes would be required to reduce the debt-to-GDP ratio. The increase in the budget balance would curtail economic growth and thereby amplify the depth of the recession. In other words, discretionary changes required to control fluctuations in the debt-to-GDP ratio would tend to pro-cyclical. A tighter degree of debt control would require discretionary change that result in a more pro-cyclical overall fiscal policy stance.

In sum, the fiscal authority faces a fundamental trade-off between conflicting policy objectives – debt control versus "policy smoothing" and economic stabilisation. Attaining a tighter degree of debt control requires sacrificing the "policy smoothing" and economic stabilisation objectives.[7]

Fiscal Policy Rules

We examine the nature of the fiscal policy trade-off using simple policy rules to evaluate alternative fiscal planning strategies. These policy rules are not intended to serve as an explicit guide for setting fiscal policy. Instead, they represent a simple, transparent way to characterise the behaviour of the fiscal authority in a stochastic simulation framework.

We consider a simple policy framework wherein the fiscal authority sets program spending and taxes at the beginning of each fiscal year. Unanticipated economic developments arise over the course of the fiscal year causing expenditures and revenues to deviate from planned levels. No tax or spending changes are made during the fiscal year. The fiscal authority revises its budget in the subsequent fiscal year taking the outcome from the previous year into account. Revisions to the fiscal plan could be done in several ways. We focus on two basic approaches, which correspond to the *flow* versus the *stock* dimension of setting fiscal policy.

Flow Rules

Under a *flow* rule, the fiscal authority plans a $3 billion budget surplus in the coming fiscal year. This is equivalent to the flow dimension of the *benchmark profile* for the debt-to-GDP ratio. When economic and fiscal developments turn out as expected, the $3 billion budget surplus implies a reduction in the debt-to-GDP ratio along the *benchmark profile*. If economic growth turns out to be weaker than anticipated, the debt-to-GDP ratio would rise above the *benchmark profile*. The fiscal authority would continue to plan a $3 billion budget surplus in the following fiscal year, without taking into account the unanticipated rise in the debt-to-GDP ratio. Because a *flow* rule focuses exclusively on the budget balance, there is control mechanism to bring the debt-to-GDP ratio back to the desired level. As a consequence, unanticipated fiscal developments cause the debt-to-GDP ratio to deviate permanently from the *benchmark profile* over time. A *flow* rule will provide some scope for debt control over the short to medium term, however. Our simulation analysis investigates this empirical issue.

Debt Rules

Debt rules, by definition, are designed to ensure that the debt-to-GDP ratio reverts to its desired level. Unlike a *flow rule*, a *debt rule* includes an error correction mechanism (represented by the deviation of the debt-to-GDP ratio from the *benchmark profile*) that takes into account the stock dimension of the fiscal situation. This ensures that the debt-to-GDP ratio reverts to the *benchmark profile* in the long run.

A straightforward way to implement a *debt rule* would be to aim for the *benchmark* debt-to-GDP *profile* in the coming fiscal year. This would entail planning the debt-to-GDP ratio for the coming fiscal year to be equal to the benchmark profile. We will refer to this particular planning strategy as a *strict debt* rule. Alternatively, the fiscal authority could implement a *debt rule* using a more gradual adjustment process. This would entail planning to bring the debt-to-GDP ratio back to the *benchmark profile* over a time horizon beyond the coming fiscal year. We refer to this planning strategy as a

[7] Elmendorf and Mankiw (1998) refer to this policy trade-off as “optimal debt policy” in their survey of the

flexible debt rule. Under a *flexible debt rule*, the debt-to-GDP ratio would fluctuate somewhat in the short run but the error correction mechanism would ensures that it reverts to the *benchmark profile* in the longer run.

A *flow rule* and a *strict debt* rule can be thought of as two extreme strategies, while a *flexible debt rule* represents somewhat of a compromise between the two.[8] A *strict* debt rule provides tight debt control at the expense of other the fiscal policy objectives, namely "policy smoothing" and economic stabilisation. A *flow rule* is more conducive to "policy smoothing" and economic stabilisation but provides little in the way of debt control. A *flexible debt rule* allows for a continuous range of possibilities between these two extremes. The flexible nature of the rule enables the fiscal authority to strike a balance between its conflicting policy objectives. We demonstrate this in the following section of the paper using stochastic simulation methods.

3. Stochastic Simulation Experiments

Methodology

Our analysis focuses on fiscal planning at the federal level.[9] The *benchmark profile* for the debt-to-GDP ratio is set to the sequence of debt-to-GDP ratios implied by $3 billion in debt reduction annually and nominal GDP growth averaging 4.3 per cent per year. This implies approximately a 20 percentage-point reduction in the debt-to-GDP ratio over a ten-year period, illustrated by the black solid line in Figure 1. This particular debt reduction scenario has no special significance. It merely serves as a benchmark for conducting the stochastic simulation experiments.

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macroeconomic implications of government debt.

[8] One can image other fiscal planning strategies. For example, the policy rule considered by Boothe and Reid (1997) aims for a budget balance averaged over several years. This would result in even less debt control that the *flow rule* used in our analysis.

[9] The fiscal measures used in our analysis are based on the national accounts definition of the federal budget balance and net debt.

The stochastic simulations experiments were performed using a small reduced-form macro model that was designed for the purpose of analysing monetary and fiscal policy rules under uncertainty. The small simple structure of the model is largely driven by computational requirements of the stochastic simulation methodology.[10] Space limitations do not permit us to give a complete description of the stochastic simulation model.[11] Instead, we will briefly outline some of the key model properties of the model with reference to monetary and fiscal policy. Let us first consider the specification of the monetary policy in our analysis.

Monetary Policy

The behaviour of the monetary authority is specified with reference to an inflation target. This is implemented using a simple policy rule of the form:[12]

$$(1) \qquad (r_t - r_t^*) = \gamma_1(E_t\pi_{t+1} - \pi^*) + \gamma_2(r_{t-1} - r_{t-1}^*)$$

where $(r_t - r_t^*)$ represents the deviation of the short-term real interest rate from its equilibrium level and $(E_t\pi_{t+1} - \pi^*)$ represents the expected deviation of the "core" inflation rate from the mid-point of the target range over the coming quarter.[13] The monetary authority's expectations are generated in a model-consistent manner so that $E_t\pi_{t+1}$ represents the model's forecast of *core* inflation in the coming quarter. The autoregressive term $(r_{t-1} - r_{t-1}^*)$ is intended to capture the "interest-rate smoothing" aspect of monetary policy. High (positive) values of the autoregressive parameter γ_2 act to

[10] Several thousand stochastic simulations are required in order to obtain accurate probability distributions for some of the simulated variables.

[11] A complete description of the stochastic simulation model is documented in Hostland (2001).

[12] Monetary policy rules of this form are sometimes referred to as "inflation forecast-based" rules in the literature (Haldane and Batini 1999). Rudebusch and Svensson (1999) provide a more elaborate discussion of semantic issues relating to the classification of monetary policy rules. The main results of our paper do not depend in an important way on the precise form of the monetary policy rule. For instance, we obtain similar results using the so-called "Taylor rule" whereby the monetary authority adjusts interest rates in response to movements in current inflation and output.

[13] "Core" inflation π_t is measured as the year-on-year change in the CPI excluding food, energy and indirect taxes.

dampen quarterly movements in short-term interest rates, which delays the monetary policy response to shocks (as shown by Taylor 1999b). “Interest rate smoothing” was originally motivated by the contention that the monetary authority seeks to curb short-run volatility in interest rates in order to preserve orderly operation of financial markets (Goodfriend 1991). More recent research has shown that “interest rate smoothing” can be motivated by other aspects of the monetary policy process such as uncertainty about data and parameters (Sack and Wieland 1999).

The inflation process is governed by the simultaneous interaction between stochastic shocks, the reaction of the monetary authority and the formation of inflation expectations. Stochastic shocks arise from several sources (including output, the exchange rate, energy and commodity prices to name a few) to displace inflation in the short run. The monetary authority reacts to impending inflationary pressure by adjusting its instrument – the short-term nominal interest rate – to raise the real cost of funds and thereby reduce aggregate demand. Inflation expectations are specified explicitly as a combination of backward and forward-looking components.[14] The term structure of interest rates is modelled using the expectations hypothesis under rational (model-consistent) expectations with constant term premia. The exchange rate is modelled using the uncovered interest rate parity condition, also under rational (model-consistent) expectations.

Inflation exhibits considerable “persistence” which prevents the monetary authority from keeping inflation at its target each period. Instead, the monetary authority endeavours to bring inflation back to its target in a gradual manner. As a consequence, inflation fluctuates around the mid-point of the target range. The parameter γ in the monetary policy rule (1) determines the sensitivity of the monetary policy response to impending inflationary pressures. Higher values of γ imply a more aggressive monetary policy stance, which results in smaller variations in inflation around its target at the expense of larger fluctuations in output and higher volatility in interest rates and the exchange rate. The monetary authority, hence, faces a fundamental trade-off between inflation control on one hand, and volatility in output, interest rates and the exchange rate on the other hand. We make no attempt to derive an optimal monetary policy rule.[15] Instead, we calibrate γ so that inflation reverts back to its target level over a two-year time horizon. In addition, our model generates *simulated* values for the output gap and changes in real interest rates and the real exchange rate that are comparable to variances of the actual variables calculated over recent years (when inflation was low and stable).

Fiscal Policy

Fiscal policy is also modelled as a partial adjustment rule. The fiscal authority in the model plans a budget at the beginning of each fiscal year. After the budget is set, stochastic shocks impact on program spending, tax revenue and debt service, causing the debt-to-GDP ratio and the budget balance to diverge from projected levels. In the subsequent fiscal year, the fiscal authority reformulates its budget plans using a simple policy rule of the following form:

(2) $$bal_t - bal_t^* = \tau \sum_{i=0}^{3} E_t(nd_{t+i} - nd^*_{t+1})$$

where $(bal_t - bal^*_t)$ is the deviation of the budget balance-to-GDP ratio from the *benchmark* level and $(nd_t - nd^*_t)$ is the deviation of the debt-to-GDP ratio from the *benchmark* level. [16]

Although the fiscal policy rule (2) is specified in terms of the budget balance, the instrument of fiscal policy is discretionary spending. This conveys the idea that a discretionary change to program spending and/or taxes is required in order to exercise debt control. For instance, when the debt-to-GDP ratio rises unexpectedly, the fiscal

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[14] This approach to modelling expectations nests adaptive expectations and rational (forward-looking model-consistent) expectations as special cases.

[15] See Taylor (1999a) and the references therein for research along these lines.

[16] As mentioned earlier, the *benchmark* level of the budget balance is simply the flow dimension of the *benchmark profile* for the debt-to-GDP ratio ($bal_t^* = nd_t^* - nd^*_{t-1}$).

authority responds by making a discretionary change (reducing program spending and/or increasing taxes) to move the budget balance toward a surplus position such that the debt-to-GDP ratio reverts to the *benchmark profile*. The reaction function is specified using the expected deviation in the debt-to-GDP ratio from the desired level over the coming fiscal year.[17] The forward-looking nature of the fiscal policy rule is consistent with the fiscal planning process, which is based on economic and fiscal projections.

The parameter τ determines the responsiveness of fiscal policy to unanticipated fluctuations in the debt-to-GDP ratio. A higher value of τ implies that the fiscal authority would bring the debt-to-GDP ratio back to the *benchmark profile* more rapidly. This would provide a tight degree of debt control, at the expense of large changes to discretionary spending and a pro-cyclical overall fiscal policy stance. In the special case where τ is set to zero, the fiscal policy rule (2) collapses into a *flow rule*. Varying τ enables us to trace out the fiscal policy trade-off.

Stochastic Simulation Experiments

The stochastic simulation procedure operates as follows. Stochastic shocks displace all the endogenous variables in the model each period. Mutually independent random shocks are drawn from a zero-mean normal distribution with variances calibrated to be roughly consistent with the historical data.[18] The stochastic simulation process runs for 40 consecutive quarters (10 years) and is repeated 1250 times.

Monetary policy is set each quarter after the stochastic shocks arrive, whereas fiscal policy is set only once every four quarters before the shocks arrive. These policy information assumptions are intended to reflect the idea that monetary policy is set on an on-going basis whereas fiscal policy measures are for the most part implemented in the context of an annual planning process that takes time to formulate and implement. In reality the information used to make policy decisions is more complicated than this. The

[17] This is very similar to the approach taken by Bryant and Zhang (1996) who include the change in the debt/GDP ratio in their analysis of fiscal policy rules to smooth the fiscal policy response.

[18] The calibration methodology is described in more detail in Hostland (2001).

monetary authority observes most asset prices (interest rates, exchange rates, and commodity prices) continuously while macroeconomic variables are reported with substantial lags (and are often subject to revision). The fiscal authority can (and does) introduce tax and spending measures outside the budget process. Our simulation results therefore pertain to the annual planning aspect of the fiscal policy process.

Results

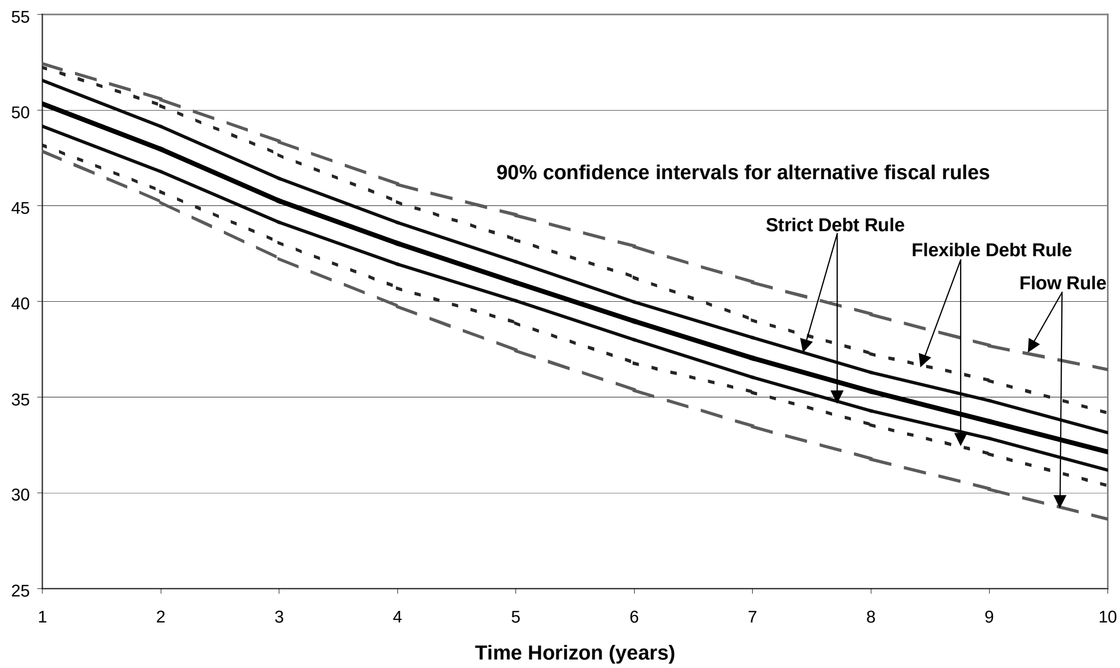
We present our simulation results by examining how the three fiscal policy rules influence each of the fiscal policy objectives.

Debt Control

Because our model and stochastic shocks are symmetric, all simulated variables are centred on their respective equilibrium values. . The (unconditional) expected value of the simulated debt-to-GDP ratio is equal to the *benchmark profile* under each policy rule. In other words, the debt-to-GDP ratio will be above the *benchmark profile* half of the time. The alternative policy rules generate different amounts of stochastic variation in the simulated debt-to-GDP ratio. This is measured using 90 per cent confidence intervals illustrated below in Figure 1.

Under a *flow rule*, the 90 per cent confidence interval widens over time, increasing from 6.3 percentage points at the three-year horizon to 7.2 percentage points at the five-year horizon and 7.8 percentage points at the ten-year horizon. In contrast, the 90 per cent confidence interval narrows over time under a *strict debt* rule, decreasing from about 2.3 percentage points at the three-year horizon to 2.0 percentage points at the five- and ten-year horizons. This reflects the fact that debt control becomes easier to achieve as the debt service burden falls over the simulation horizon. This does not occur under a *flow rule* because the variance of the debt-to-GDP ratio rises over the simulation horizon making debt service costs more volatile, even though the debt service burden is lower on average.[19]

Figure 1: Stochastic Variation in Net Debt as a percentage of GDP



The degree of debt control attained under a *flexible debt* rule depends on the parameter τ in the fiscal policy rule (2). Figure 1 illustrates the case where τ is set to a value of 0.1. The 90 per cent confidence interval narrows over time (as in the case of a *strict debt* rule), declining from 4.6 percentage points at the three-year horizon to 4.3 percentage points at the five-year horizon and 3.8 percentage points at the ten-year horizon.

It is important to note that these estimates depend to some extent on the calibration of the model. Sensitivity analysis was performed provide some insight into the

[19] From an econometric perspective, deviations in the debt/GDP ratio from the *benchmark profile* are non-stationary (integrated of order one) under a *flow* rule. The error correction mechanism underlying (strict and flexible) debt rules causes the debt/GDP ratio to revert to the *benchmark profile* over time, so that deviations are stationary (integrated of order zero).

robustness of the estimates. This entailed running stochastic simulations using alternative specifications of the model.[20] The results indicated that the estimated confidence intervals for the debt-to-GDP ratio are quite robust under flexible and strict debt rules. In contrast, the estimates obtained using a flow rule displayed a significant range of variation. One factor that was found to be of particular importance in this regard was the amount of variation in inflation. Higher variation in inflation leads to a much wider confidence interval for the debt-to-GDP ratio under a *flow rule*.

The intuition for this result is as follows. Higher variation in inflation implies higher variation in nominal GDP. The error correction mechanism underlying *strict* and *flexible debt* rules ensures that the level of debt (in nominal terms) adjusts to permanent changes in the price level. This is not the case, however, under a *flow rule*. The amount of uncertainty surrounding the debt-to-GDP ratio cumulates over time as a consequence. Higher variability in inflation leads to a substantially higher amount of uncertainty surrounding the debt-to-GDP ratio over the long term.

To illustrate, we conducted stochastic simulations using an alternative calibration of the model that entailed a much higher amount of variation in inflation. The "benchmark" version of the model used to generate the results shown in Figure 1 was calibrated to be consistent with the current inflation targeting framework. The inflation series simulated by the model has a standard deviation of 0.95 percentage points.[21] This was raised to about 2.25 percentage points under the alternative calibration of the model.[22] Raising the amount of variation in inflation by this amount led to an increase in the 90% confidence interval for the debt-to-GDP ratio from 7.8 to 17 percentage points at

[20] We varied those elements of the model that have the greatest influence on fiscal variables. This included making changes to the automatic stabilisation properties of fiscal revenues and expenditures, the magnitude of the stochastic shocks on fiscal revenues and expenditures and the response of output to changes in the primary budget balance.

[21] This calculation refers to the *core* inflation rate, measured on a year-on-year basis.

[22] To put this comparison into a historical perspective, the standard deviation of *core* inflation (the quarterly percentage change in the CPI excluding food and energy prior) declined from 2.8 percentage points over the period 1971 to 1991 to about 0.75 percentage points over the period 1992 to 2000.

the ten-year horizon. This demonstrates that under a *flow rule* the amount of uncertainty surrounding the debt-to-GDP ratio depends on the inflation process to a great extent. This is not the case for a *strict debt* rule. Under a *flexible debt rule*, the confidence interval for the debt-to-GDP ratio depends on the amount of variation in inflation, but to a much less degree than under a *flow rule*.

"Policy Smoothing"

As mentioned earlier a tighter degree of debt control requires larger discretionary changes to program spending and/or taxes. This raises the risk of having to "backtrack" on announced tax and spending measures if future economic conditions turn out to be weaker than anticipated. We provide some insight into this risk by examining the amount of variation in discretionary spending implied by each of the alternative fiscal policy rules.[23] This is summarized in Table 1 below.

Table 1: Variation in discretionary spending
Standard deviation of discretionary spending as a percentage of GDP

	Planning horizon		
Fiscal policy rule	*Three years*	*Five years*	*Ten years*
Flow rule	0.28	0.32	0.33
Flexible debt rule (τ = 0.1)	0.51	0.53	0.52
Strict debt rule	1.88	1.62	1.48

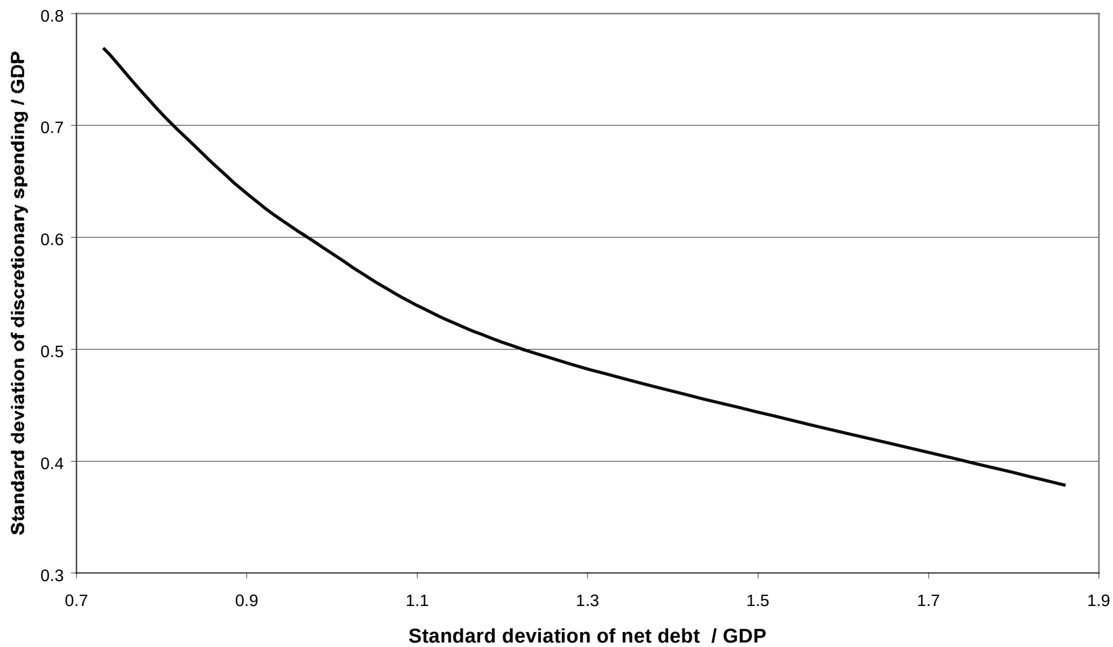
Recall that under a *flow rule* the fiscal authority plans for a $3 billion surplus in each coming fiscal year regardless of projected and past fiscal developments. This requires small changes in discretionary spending. Larger discretionary changes are required under a debt rule in order to confine fluctuations in the debt-to-GDP ratio. Table

[23] Discretionary spending can be interpreted as changes to program spending and/or taxes.

1 compares the amount of variation in discretionary spending (as a percentage of GDP) under the three fiscal policy rules. Under a flow rule, discretionary spending exhibits a standard deviation of about 0.3 per cent of GDP (approximately $3 billion in 2000). This rises to about 0.5 per cent of GDP (approximately $5 billion in 2000) under a flexible debt rule (in the case where τ is set to 0.1). A strict debt rule would require a much higher amount of variation in discretionary spending. For example, at the three-year planning horizon discretionary spending would vary with a standard deviation of about 1.88 per cent of GDP (approximately $18.8 billion in 2000). The fiscal authority would be unable to make discretionary changes of this magnitude without having to “backtrack” on announced tax and spending measures. For this reason, a strict debt rule can be considered to be infeasible.

It is more difficult to assess whether or not a flexible debt rule is feasible because the amount of variation in discretionary spending depends on the parameter τ. This is illustrated in Figure 2 below which shows the trade-off between the debt control objective and the “policy smoothing” objective. Higher values of τ result in a tighter degree of debt control (measured by the standard deviation of the debt-to-GDP ratio on the horizontal axis) along with higher variation in discretionary spending as a percentage of GDP (measured on the vertical axis). Figure 2 illustrates the extent to which a policy maker could sacrifice its debt control objective in order to make smaller changes to discretionary spending (and thereby avoid the risk of having to backtrack on announced tax and spending measures).

Figure 2: Trade-off between Debt Control and "Policy Smoothing" Objectives

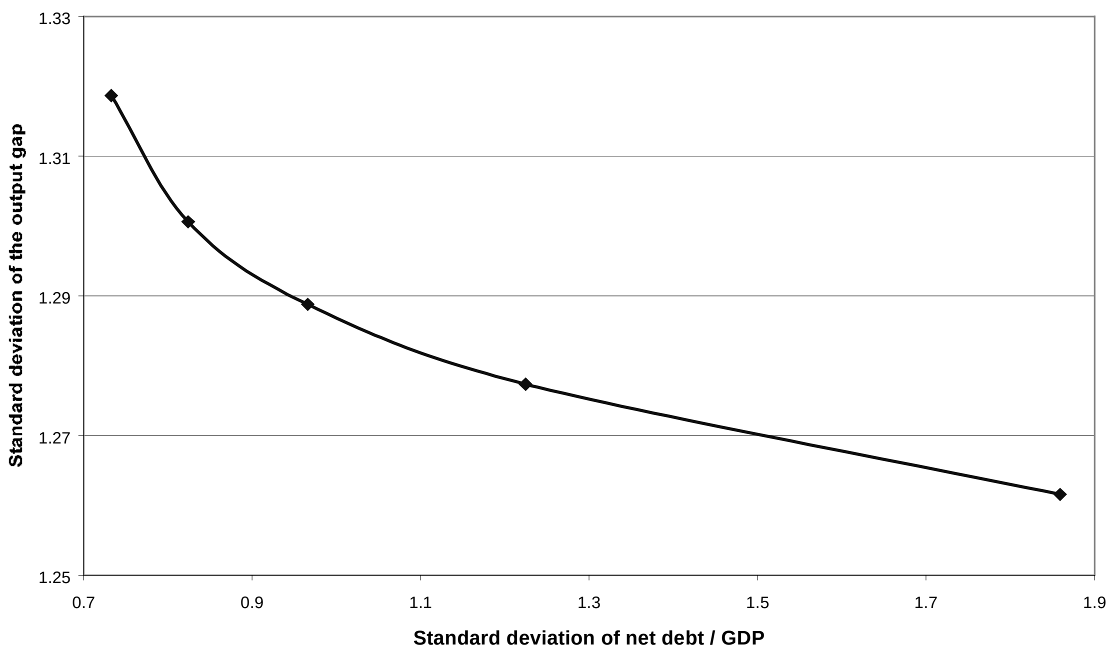


Economic Stabilisation

We assess the capacity of each fiscal policy rule for providing economic stabilisation by measuring the extent to which fiscal policy influences cyclical fluctuations in output. Discretionary changes required to control fluctuations in the debt-to-GDP ratio are pro-cyclical and hence, act to amplify cyclical fluctuations in output. For example, output has a standard deviation of 1.0 per cent under a flow rule. A strict debt rule would provide more debt control, but at the cost of less economic stabilisation – the standard deviation of output increases to 1.5 per cent.

In the case of a flexible debt rule, the amount of output variation depends on the policy parameter τ. This is illustrated in Figure 3 below which shows the trade-off between the debt control objective and the economic stabilisation objective. Higher values of τ result in a tighter degree of debt control, which is measured by the standard deviation of the debt-to-GDP ratio on the horizontal axis (moving toward the origin). A tighter degree of debt control results in higher variation in output, which is measured on the vertical axis. Figure 3 illustrates the extent to which a policy maker could sacrifice its debt control objective to dampen cyclical fluctuations in output.

Figure 3: Trade-off between Debt Control and Economic Stabilisation Objectives



4. Conclusions

To summarize, we find that a medium-term fiscal planning strategy that focuses exclusively on the budget balance would require a fairly wide target range. Our estimates indicate that the debt-to-GDP ratio would have a 90 per cent confidence interval in the range of about 7 to 12 percentage points at the ten-year planning horizon. In contrast, a strategy that aims to return the debt-to-GDP ratio to its desired level in each coming fiscal year would provide a tight degree of debt control. Our estimates indicate that the debt-to-GDP ratio would have a 90 per cent confidence interval of about two percentage points at the ten-year planning horizon. However, such a strategy would require large and frequent discretionary changes to program spending and/or taxes and result in a pro-cyclical fiscal policy stance. This would require having to backtrack on announced tax and spending measures frequently. On this basis, we conclude that such a strategy would be infeasible.

This paper demonstrates how a *flexible debt rule* could be used to balance the trade-off between the conflicting fiscal policy objectives. This entails responding to unanticipated fiscal developments by making discretionary changes that will bring the debt-to-GDP ratio back to its desired level in a gradual manner. Our stochastic simulation results indicate that a medium-term planning strategy along these lines could provide a moderate amount of debt control without excessive discretionary changes. In addition, a *flexible debt rule* would allow for some scope to make discretionary changes in a counter-cyclical manner.

The simulation results are instructive for the purposes of characterizing the nature of the fiscal policy trade-off. In particular, Figures 2 and 3 provide a convenient way to illustrate the trade-off facing policy makers. But because we have only a rather vague idea about the relative weights that should be assigned to the conflicting policy objectives, we can only speculate about what would constitute an "optimal" planning strategy. This question is beyond the scope of the paper. It is also important to recognize that our analysis does not provide a firm basis for guiding fiscal policy decisions. Considerably more work would be required to make the simple policy rules examined in this paper operational.

We should add that this is an on-going area of research and several issues warrant further examination. One policy option of particular interest that was not addressed in this paper is the possibility of keeping the debt-to-GDP ratio under a *ceiling*, as opposed to a *range*.[24] Several outstanding issues must be addressed before one could recommend a particular fiscal policy rule that could actually be used in practise. Let us highlight a few issues that merit special attention in the research agenda.

First, the only source of uncertainty in our analysis is the stochastic shocks, which we interpret as unanticipated economic developments. The monetary and fiscal authorities in our model understand the structure of the economy and use this information to set policy. In reality, uncertainty about the structure of the economy greatly

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[24] This policy option is examined by Georges (2001).

complicates policy decisions. Our simulation results understate the amount of uncertainty facing policy makers in this respect. The importance of model uncertainty deserves close attention in future research.[25]

Second, our analysis focused on fiscal planning at the federal level only. It would be of interest to extend our analysis to include fiscal policy developments at the provincial level as well. This would enable us to gauge the potential benefits of co-ordinating fiscal policies at the federal and provincial levels.

Third, the impact of changes to the fiscal policy stance on economic activity has an important influence on the policy trade-off examined in this paper. There is, however, much disagreement about the nature of the linkages and the precise magnitudes involved. For example, Robson and Scarth (1999) find that the stabilisation role of fiscal policy has relatively minor implications for dampening cyclical fluctuations in output. We are able to overturn this result in our model is calibrated such that changes to the fiscal policy stance have a strong impact on economic activity. The empirical and theoretical specification these linkages warrants further research.

On a final note, we wish to stress that the simulation results reported in this paper depend on the specification of our model (as in all simulation studies). Several controversial modelling issues arise when specifying a macroeconomic model. We do not claim to have resolved any of the difficult modelling issues. Given the high degree of uncertainty surrounding macro modelling, we are ultimately interested in drawing policy conclusions that are robust across a wide range of alternative model structures and parameter values. Sensitivity analysis hence plays a central role in our research agenda.

[25] Robson and Scarth (1999) incorporate parameter uncertainty into their stochastic simulation analysis of fiscal planning issues.

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