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GOVERNMENT DEBT AND DEFICITS IN CANADA:
A Macro Simulation Analysis

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Tiff Macklem, David Rose
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Research Department
Bank of Canada, Ottawa, Ontario K1A OG9

Preface

An earlier version of this paper was presented at the C. D. Howe Institute's conference "Deficit Reduction: What Pain, What Gain?" held in conjunction with the Annual Meetings of the Canadian Economics Association, 10 June 1994, at the University of Calgary, Calgary, Alberta. A shorter version of the paper is published in the C. D. Howe Policy Study 23, which is titled after the conference. A summary of the research has also been published in the *Bank of Canada Review* (winter 1994-95). We are very grateful to Bill Robson and Bill Scarth (the editors of the C. D. Howe volume) for inviting us to pursue this project and for their helpful comments and suggestions. Thanks are also due to the conference participants, particularly Steven James and our discussant John McCallum, and to several colleagues at the Bank of Canada, especially Bernard Bonin, Pierre Duguay, Irene Ip, Paul Jenkins, Brian O'Reilly and Steve Poloz. We also gratefully acknowledge the help of our colleagues Richard Black, Leo Butler, Don Coletti and Ben Hunt in preparing the simulations reported in this paper, and the assistance of Chris Lavigne in preparing the graphs.

We can be reached by telephone, fax or via the Internet:

E-mail addresses: tmacklem@bank-banque-canada.ca
drose@bank-banque-canada.ca
btetlow@bank-banque-canada.ca
Telephone: (613) T. Macklem 782-8473
D. Rose 782-8728
R. Tetlow 782-8670
Fax: (613) 782-7163

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CONTENTS

Abstract

This paper examines the macroeconomic implications of rising government debt in Canada and the short-run costs and long-run benefits of stemming the rise.

The discussion begins with an evaluation of the long-run consequences of increasing government indebtedness, first based on the simple arithmetic of the government's long-run budget constraint, and then based on simulations of the Bank of Canada's main model of the Canadian economy, which incorporates several channels through which government debt may affect real economic activity. The principal conclusion is that the main economic cost of higher government debt is a lower sustainable level of domestic consumption.

Simulations with the full dynamic model highlight the trade-off of short-run loss for long-run gain presented by deficit reduction. There are important short-run costs of stemming a rise in debt. However, the results of this paper show that substantial net gains are obtained from doing so, since the present value of the permanent long-term gains in consumption far outweigh these short-term costs. The simulations also suggest that a fiscal contraction would require an easing of monetary conditions relative to what they would have otherwise been to maintain an inflation target.

Résumé

Les auteurs examinent les répercussions macroéconomiques de l'accroissement de la dette publique au Canada ainsi que les avantages et les inconvénients qui sont liés, à long et à court terme respectivement, à une décélération de cette dernière.

Les auteurs commencent par évaluer les conséquences à long terme d'un accroissement de l'endettement du secteur public en s'appuyant d'abord sur un calcul simple de la contrainte budgétaire à long terme du secteur public, puis sur des simulations effectuées à l'aide du principal modèle que la Banque utilise pour représenter l'économie canadienne. Ce modèle incorpore différents mécanismes permettant à la dette du secteur public d'influer sur l'activité économique réelle. La principale conclusion que tirent les auteurs est qu'une baisse permanente du niveau de la consommation intérieure constitue le plus important coût économique que peut engendrer l'accroissement de l'endettement du secteur public.

Les simulations effectuées à l'aide du modèle dynamique complet font ressortir l'arbitrage qui existe entre les pertes à court terme et les gains à long terme découlant d'une réduction du déficit et indiquent que les coûts à court terme d'une décélération de la dette sont importants. La présente étude montre toutefois qu'un tel ralentissement donne lieu à des gains nets substantiels, étant donné que la valeur actuelle de l'accroissement permanent à long terme de la consommation est de loin supérieure aux coûts à court terme. Les simulations laissent également supposer qu'un resserrement de la politique budgétaire nécessiterait des conditions monétaires plus souples que ce ne serait le cas si une cible de réduction de l'inflation était maintenue.

1 Introduction

Since the early 1980s, the ratio of government debt to gross domestic product (GDP) in Canada – the debt-to-GDP ratio – has risen sharply. At the end of the 1960s the level of consolidated public sector net debt was 12.5 per cent of GDP.[1] A decade later this ratio was virtually the same. But, by the end of the next decade, the 1980s, the net debt-to-GDP ratio had risen to almost 40 per cent, and by the end of 1993 it had surpassed 60 per cent.

Canada has not been alone in experiencing escalating levels of government indebtedness, but in comparison to other countries, Canada's debt-to-GDP ratio is now distinctly on the high side. Among the G-7 countries, only Italy has a higher ratio, and among the 15 member countries of the Organisation for Economic Co-operation and Development (OECD) for which we have data on net public debt for 1993, Canada ranked third highest for its debt-to-GDP ratio, following Belgium and Italy.[2] For the G-7 as a whole, net public debt averaged about 46 per cent of GDP in 1993, and if we exclude Canada and Italy, the average drops to 30 per cent of GDP, or about half as large as the debt-to-GDP ratio in Canada.[3]

Rising government indebtedness poses a challenge. Debt-to-GDP ratios cannot rise indefinitely. As the outstanding stock of debt grows relative to the

1. Net debt is measured here on a national accounts basis as the gross debt of the public sector less its financial assets. The data come from Statistics Canada's national balance sheet accounts and are a consolidation of data from federal, provincial and municipal governments, hospitals and the Canada and Quebec Pension Plans. It should be noted that these pension plans are operated on a pay-as-you-go basis and are treated as having assets but no liabilities. The debt figures most often cited by financial analysts and the media are considerably higher than those used in this paper, because they are based on a different accounting framework – specifically, the public accounts of the federal, provincial and municipal governments – and exclude hospitals and the Canada and Quebec Pension Plans, while including government borrowings from public employee pension accounts. The use of national accounts data in this paper is not meant to imply that this is the preferred approach to measuring the government debt. Rather, it is motivated by the fact that the macroeconomic simulation model on which much of the analysis is based has an accounting framework that is consistent with the national accounts.

2. See OECD (1993). If we use gross instead of net public debt, the OECD (1993) data span 19 member countries (instead of 15), and Canada's debt-to-GDP ratio is ranked fifth highest in 1993 behind those of Belgium, Italy, Greece and Ireland.

3. See OECD (1993). The averages noted in the text are unweighted averages. The GDP-weighted average debt-to-GDP ratio for the G-7 as a whole was 38 per cent.

economy's productive capacity, the burden of debt service becomes increasingly difficult to support and lenders may demand a higher return to supply funds to governments. The challenge in Canada and elsewhere is, at a minimum, to halt the rise in the debt-to-GDP ratio and to reestablish a sustainable path for fiscal policy. This requires some combination of higher tax revenues and lower government expenditures relative to the size of the economy. The full challenge for fiscal policy is to address the issue of what levels of the debt and the deficit should be considered *optimal* as a long-term goal.

The debt challenge raises a number of important questions. What are the long-run implications of higher debt levels for aggregate output, employment, consumption, investment and the trade balance? How does public-sector debt impact on our net international indebtedness? What are the implications of higher debt levels for taxes or transfers? What are the dynamic or short-run effects of alternative deficit-reduction strategies? How do the short-run costs of deficit reduction compare with the long-run benefits? And what is the nature of the interaction between fiscal and monetary policy in a setting of deficit reduction?

This paper offers some tentative answers to these and other questions in the Canadian context through use of a new model of the Canadian economy called QPM (Quarterly Projection Model). QPM is a dynamic simulation model developed at the Bank of Canada for economic projections and policy analysis.[4] In comparison to most other models used for similar purposes, QPM is a relatively small model. This reflects a conscious decision to abstract from the micro-sectoral details of the Canadian economy and focus on the core macro linkages in a theoretically consistent framework that takes full account of long-run budget constraints. The long-run equilibrium of QPM is determined by a

4. QPM has been in regular use at the Bank of Canada since the autumn of 1993, when it replaced RDXF as the main model used by Bank staff. See Poloz, Rose and Tetlow (1994) for an overview of the model and its use at the Bank. Some medium-term implications of fiscal experiments were investigated using a prototype of QPM in Laxton and Tetlow (1992).

steady-state model – known as SSQPM – that is firmly grounded in intertemporal optimization theory.[5] The full model is dynamically stable and will produce simulations of dynamic adjustment paths that converge on the steady state. This is particularly important for the analysis of issues like government debt. Since the short-run effects of higher government debt are quite different from the long-run effects (when the implications for debt service and taxation must be recognized), it is especially important that an analysis of fiscal policy that involves a permanent change in the level of debt be carried through to its longer-term conclusions and not stop at the short-run effects. Otherwise, the policy analysis risks being seriously misleading, owing to the all-too-easy "free lunch" that may appear to be available from short-term deficit financing of spending.

While QPM devotes considerable attention to the medium-term adjustment that is required to respect long-run budget constraints, it also attempts to capture the essential features of the short-run dynamics of the Canadian economy. The model has been calibrated to reproduce a mixture of properties from reduced-form econometric models and various stylized facts taken from the data, as well as a number of important judgments by Bank staff as to how to characterize the steady state. Thus, while QPM is not estimated using standard econometric methods, it is based on the Canadian data in the sense that is most meaningful for policy analysis.

Notwithstanding the suitability of QPM for the exercise at hand, the basic model does have some important limitations in terms of what has been included from the menu of possible links between government debt and the real economy. For example, the model assumes lump-sum taxation of income and therefore does not entertain any possible economic distortions from changes in the level of taxation. Recent evidence suggests that this could lead to an important understatement of the possible negative consequences of higher levels of debt.

5. SSQPM is documented in Black, Laxton, Rose and Tetlow (1994).

Second, while the basic model includes risk premiums on government debt and net foreign liabilities, these are exogenous and held fixed in standard simulations. There is, however, growing evidence that governments will face higher interest rates if they continue to increase the level of debt. In our analysis, we begin with simulations of QPM, but we also extend the model to include both of these effects and some other effects that arise from the consideration of expectations and credibility during transitions.

It is perhaps also advisable to be clear on what this paper does not set out to do. In particular, we make no attempt to analyse specific government spending programs or taxes, and we make no distinction between the different levels of government. Our approach is more macro in nature; we focus on the government's budget constraint, consolidated so that all levels of government are unified, and examine the long- and short-run macro implications of changes in the level of overall public-sector debt. In addition, we focus our analysis further by constraining all fiscal adjustments to come through either taxes or transfers; that is, the analysis takes the level of government expenditures on goods and services as fixed. In doing so, we do not mean to suggest that an optimal fiscal policy would not involve some changes in the level of government spending on goods and services. However, QPM, like most macro models, makes no attempt to characterize the benefits of the various government spending programs. Thus, we consider only adjustments to taxes net of transfers, which are fully integrated into the model's behavioural structure. Finally, we take as given that the objective of monetary policy is to maintain inflation at the mid-point of the 1 to 3 per cent target range for inflation announced jointly by the Bank of Canada and the federal government.

The remainder of the paper is organized as follows. The next section – Section 2 – begins by reviewing the simple arithmetic of the government's long-run budget constraint. We use this arithmetic to document the implications of the recent rise in debt and to look at the implications of higher debt levels for taxes and government expenditures under the counterfactual assumption that "everything else remains unchanged." Section 3 introduces QPM and outlines the effects of government debt in the base model and in an extended version that allows for the possible distortionary effects of income taxation on labour supply and endogenous risk premiums on government debt. The model is then used to provide some quantitative guidance as to the effects of recent increases in government debt and the predicted future effects if the debt-to-GDP ratio continues to rise. We also examine the dynamics of the economy as it shifts between different debt levels. With this as background, Section 4 examines the effects of fiscal policies aimed at either stemming or reversing the recent rise in debt, and the implications of these fiscal policies for monetary policy. We conclude with a brief summary.

2 The arithmetic of debt and deficits

Before turning to the economic effects of government debt and deficits, it is useful to examine the simple arithmetic that links the budget deficit to expenditures, taxes, and the outstanding stock of government debt. With our macro focus, it is convenient to aggregate all aspects of the public sector into a single entity, which we call "government." For this discussion, it is also helpful to set aside such complications as public sector assets and the consequent complexities of gross and net accounting. In addition, we simplify the analysis further by assuming that all debt rolls over each period to avoid having to keep track of effective average interest rates. Since we are concerned only with long-term implications of the government's budget contraint here, this assumption is innocuous.

In our simplified economy, the government's outlays can be conveniently divided into three categories: expenditures on goods and services, transfers to the private sector (such as social assistance to households and business subsidies) and interest payments on the debt. The government finances these outlays with tax revenues and the net proceeds of issuing new debt, subject to the constraint that the change in the outstanding debt – the deficit – equals the difference between the government's expenditures and its tax revenues.[6] Algebraically, we have

$$D_t = B_{t+1} - B_t = i_t B_t + G_t + TR_t - TAX_t, \tag{1}$$

where D_t is the period-t deficit, B_t is the stock of government debt outstanding at the start of period t, i_t is the nominal interest rate the government pays on its debt in period t, G_t is government expenditures on goods and services, TR_t is transfers to private agents, and TAX_t is the government's tax revenue. In any given period, the government can choose the combination of taxes and deficits that it uses to finance its expenditures, but this choice has implications for the government's budget constraint in the next period. Other things equal, the more the government relies on deficit finance in the current period, the greater the stock of debt that it will have to service in the next period will be.

A minimal long-run condition for the sustainability of fiscal policy is that the government's debt service cost, and thus the debt itself, cannot rise indefinitely relative to the productive capacity of the economy. Therefore, one way to address the long-run consequences of debt in the context of a sustainable policy is to consider the implications of maintaining a stable ratio of debt to GDP. Combining this long-run constraint of a constant debt-to-GDP ratio with the dynamic or short-run budget constraint (1) yields the following long-run budget constraint facing the government:

$$zB = iB + G + TR - TAX, \tag{2}$$

6. To keep the exposition simple, our presentation of the arithmetic also ignores the existence of money and seigniorage, although QPM contains a full accounting. At moderate rates of inflation, seigniorage is relatively small and the ability of the government to generate revenue by printing more money is limited by the inverse relationship between inflation and the demand for real money balances. There are, however, other possible sources of non-neutrality, arising from the tax system, that may be quantitatively important but which are ignored in this paper. See Black, Macklem and Poloz (1994).

where z is the growth rate of nominal GDP and the time subscripts have been dropped to reflect the fact that this is a long-run condition. Equation (2) yields two important insights into the combinations of debt, deficits, expenditures and taxes that are consistent with a constant debt-to-GDP ratio.

First, note that the right-hand side of (2) is simply the deficit; thus, in the long run the deficit is simply proportional to the level of the debt, and the factor of proportionality is the rate of nominal income growth:

$$D = zB. \tag{3}$$

The implication is that to sustain a constant debt-to-GDP ratio in an economy with debt and a positive long-run growth rate of nominal income, the government must run a deficit. The simple reason is that with positive nominal income growth, the real value of the outstanding stock of debt would be declining relative to the productive capacity of the economy unless the government were to add new debt – run a deficit – each period. For example, suppose that long-run nominal income growth is 4.5 per cent (say 2 per cent inflation and 2.5 per cent real growth). If fiscal policy were aimed at maintaining the current observed net debt-to-GDP ratio of roughly 60 per cent, then the government's annual budget deficit would have to be 2.7 per cent of GDP. For 1993 this would have been some $19 billion, which is almost 40 per cent of the actual consolidated government deficit of about $49 billion.

The second insight provided by equation (2) is that the extent to which the level of its debt has a negative effect on the government's financial position depends critically on the difference between the real interest rate and the real growth rate of the economy. To see this, rearrange (2) to obtain

$$(r - x)B = TAX - TR - G, \tag{4}$$

where $r = i - \pi$ is the real interest rate, $x = z - \pi$ is the growth rate of real GDP and π is the rate of inflation. If the real interest rate, r, is greater than the real growth rate, x, then taxes must exceed primary expenditures – total government expenditures net of interest payments on the debt (which is equal to the sum of transfers to the private sector and government spending on goods and services). Moreover, higher debt levels imply that taxes must rise or primary expenditures fall. If, on the other hand, the real interest rate is less than or equal to the real growth rate, higher debt does not require either higher taxes or lower primary expenditures to be sustained. In fact, if $r < x$, primary government expenditures must exceed tax revenues to maintain a constant debt-to-GDP ratio. The simple reason is that to maintain a constant debt-to-GDP ratio with $r < x$, the government needs to issue new debt faster than the interest on the outstanding debt is cumulating. In this rather fortunate case, the government can borrow, pay the interest on this loan with new debt, and still have a surplus left over that can be used either to increase primary expenditures or lower taxes.

This latter insight goes part way towards explaining why the debt-to-GDP ratio changed little through the 1960s and 1970s, but then rose sharply. Table 1 reports averages for the past three decades of the principal components of the government's budget constraint (expressed as a ratio of GDP), as well as comparable averages for real growth rates and a measure of the real interest rate.[7] Averages for the first four years of the current decade are also reported, but these are dominated by the cyclical downturn in 1990-91 and do not, therefore, provide the medium-term or average-of-cycle perspective of the full-decade averages.

These data show that while $r - x$ was negative, on average, in the 1960s and 1970s, it was positive in the 1980s. As a result, the levels of primary expenditures and taxes that were consistent with a constant debt-to-GDP ratio in the 1960s and 1970s were not consistent with such an outcome in the 1980s. The

7. The real interest rate is measured as the average yield on 10-year-or-more Government of Canada bonds less the year-over-year growth in the GDP price deflator. This does not always provide a good measure of the effective average rate on *net* debt, but we have no reliable measure of that rate for our consolidated public sector for the entire period. We think that use of a representative interest rate gives us a reasonable picture of the *changes* in circumstance across decades, which is our focus here.

Table 1: The government's budget constraint, interest rates and growth

Proportion of GDP (%)	**1961-69***	**1970-79**	**1980-89**	**1990-93**	**1961-93**
TAX	29.1	33.8	34.8	38.4	33.4
PRIMARY EXPENDITURE	26.9	33.1	36.1	40.1	33.2
- goods and services	19.4	22.2	22.3	23.6	21.7
- transfers	7.5	10.9	13.9	16.5	11.5
DEFICIT	-0.2	0.2	4.3	6.0	2.0
*NET DEBT (end of period)***	12.4	12.5	39.1	60.8	60.8
Level (%)					
Real interest rate (r)	2.8	1.1	6.2	7.2	3.8
Real growth rate (x)	5.3	4.6	3.0	0.2	3.8
r - x	-2.5	-3.5	3.2	7.0	0.0

* Calculations start in 1961 because complete data for 1960 are not available.

** Constructing a consistent set of consolidated stock and flow accounts is a very difficult task, and problems invariably exist with the data. Of particular importance in the current context is the fact that the consolidated government deficit figures do not cumulate exactly to the reported levels of consolidated net government debt. As a result, the accounting identities given in equations (3) and (4) do not in fact hold exactly in the data. However, while it is important to be aware of these limitations of the data, the limitations are not serious enough to compromise the historical analysis. Moreover, for the more forward-looking analysis in the rest of the paper, this difficulty does not arise, as exact stock-flow cumulation is imposed in the calculations.

increase in $r - x$ in the 1980s raised debt service costs, and a constant debt-to-GDP ratio could have been maintained only if primary expenditures were reduced or taxes were increased. In fact, both taxes and primary expenditures rose as a proportion of GDP in the 1980s, but primary expenditures increased more than taxes. As shown in Table 1, the rise in primary expenditures can be traced almost entirely to increases in government transfers to the private sector, so while taxes rose in the 1980s, taxes net of transfers fell. This combination of larger debt service costs and lower taxes net of transfers resulted in large deficits throughout the 1980s, the cumulative effect of which was to more than triple the debt-to-GDP ratio by the end of the decade.

The long-run relationships given in (3) and (4) also provide a useful starting point for discussing possible future paths for the debt, the deficit, taxes and expenditures. The extent to which current levels of taxes and expenditures are sustainable in the long run depends critically on the difference between r and x. If $r - x$ were to turn negative on average, as in the 1960s and 1970s, the debt-to-GDP ratio could, in principle, stabilize without any change in taxes or expenditures. Both history and economic logic suggest, however, that this scenario is unlikely.

Taking a longer view, it is clear that periods in which growth has exceeded the real interest rate are the exception. The 1950s and 1960s were periods of unusually high productivity growth, resulting in output growth that temporarily exceeded the real interest rate on government debt. In the 1970s, productivity growth returned to more normal levels, but most industrialized economies experienced a sharp and unexpected rise in inflation. Slow adjustment of inflation expectations to higher rates of inflation after a long period of relatively low and stable inflation would account for the very low realized real interest rates that were experienced in the early to mid-1970s.[8] Another explanation for the 1970s is that the marginal product of capital may have been depressed temporarily by the oil-price shocks.

There is also an economic argument for the real interest rate to exceed the growth rate of real output in the long run. If the real interest rate were below the growth rate of the economy, then firms and households could borrow, pay the interest on their debt with the additions to output stemming from growth, and still have a surplus left over. In such circumstances, everyone would want to borrow, in which case the demand for loans would exceed the supply, putting

8. See Laxton, Ricketts and Rose (1994) for a model with this property.

upward pressure on the real interest rate. The rise in the real interest rate would encourage individuals to save, while discouraging borrowing, thereby balancing the demand and supply of loans. Market forces will tend to push the real interest rate above the growth rate of real GDP if households prefer current consumption to future consumption on average, since lenders will have to be compensated for deferring their consumption to the future.[9]

These considerations suggest that a prudent assumption on which to base fiscal policy is that the real interest rate will exceed the real growth rate over the long term. With r greater than x on average, the implication of equation (4) is that either tax revenues must rise or primary expenditures must fall to stabilize the debt-to-GDP ratio. The degree to which r will exceed x, however, remains an open question. Accordingly, Table 2 reports combinations of debt, deficits, taxes net of transfers and other expenditures that are consistent with (3) and (4) under three alternatives for $r - x$. For illustration, the real growth is set at 2.5 per cent consistent with the gradual slowing in real growth since the 1960s, and inflation is set at 2.0 per cent consistent with the mid-point of the announced inflation control targets.[10] The table then considers three alternatives for the equilibrium real

9. This argument focusses on productivity growth, but similar economic reasoning goes through for the case of population growth. The higher the rate of population growth is, the greater the rate of investment in physical capital required to maintain the stock of physical capital per person will be. This higher rate of investment raises the demand for loans and thus the real interest rate. The implication of this argument is that the long-run real interest rate that equates the demand and supply of loans will be above the rate of population growth if consumers prefer current to future consumption on average. Life-cycle considerations, such as saving for retirement, and market imperfections that restrict borrowing against future income could act as a counterweight. Similarly, for a small open economy, like Canada’s, conditions in world financial markets are very important. When a country has an extraordinarily high real growth rate relative to the rest of the world, in a rapid development phase for natural resources, for example, it may well be possible to borrow in world markets at a real rate lower than the domestic real growth rate. However, there is no reason to think that this argument applies to Canada in the 1990s.

10. Slower average real growth in Canada since the mid-1970s can be traced to slower growth among Canada’s trading partners, and the narrowing productivity gap between Canada and the United States as the gains from catch-up have been exploited. This trend can be expected to continue, suggesting a forecast for average long-run real growth of between 2 and 3 per cent. We assume a long-run growth rate of 2.5 per cent for this study.

interest rate: 3.5 per cent, 5.0 per cent and 6.5 per cent.[11]

Consider first the case where the level of government spending on goods and services is fixed exogenously at 22 per cent of GDP and taxes net of transfers must adjust to respect the long-run budget constraint. This case is shown in the results in the top part of the table (excluding the bottom panel). Since $r > x$ for all three interest rate alternatives, higher debt-to-GDP ratios imply that taxes net of transfers must rise, requiring some combination of higher taxes and lower transfers. In addition, the degree to which taxes net of transfers must rise is larger the bigger the difference is between r and x. Note, however, that the rate at which taxes net of transfers must increase, as the debt-to-GDP ratio rises, is considerably lower than the rate at which the debt-service costs climb with rising indebtedness. The reason – as highlighted by equations (3) and (4) – is that the effective net cost of financing each unit of debt is only $r - x$, since part of the gross cost can be funded each period through the new debt issue that is *required* to keep pace with the growth in GDP.

Higher debt levels could also be sustained by reducing government expenditures on goods and services instead of raising taxes. The arithmetic of this option is shown in the bottom panel of Table 2. Specifically, taxes net of transfers are held at 22 per cent of GDP and government expenditures adjust to sustain higher debt. The adjustments to government expenditures on goods and services

11. The long-run real interest rate is particularly difficult to pin down, since the cause of the higher real interest rates in the 1980s and 1990s remains an open question. If the higher real interest rates of the 1980s resulted from an investment boom associated with a rise in the expected profitability of capital (as argued, for example, by Barro and Sala-i-Martin, 1990) or from the slow adjustment of expectations to lower rates of inflation as public confidence that inflation would not return to previous levels built up only gradually, then real interest rates could be expected to converge on, say, their average level over the 1961 to 1993 period of 3.5 to 4 per cent (Table 1). If, on the other hand, higher real interest rates in the 1980s and 1990s were due, even in part, to the increased demand for loans stemming from the rise in government indebtedness that has been experienced in many industrialized countries, or rising risk premiums on Canadian government debt due to the high level of debt relative to GDP in this country, then real interest rates would be expected to remain above their historical average for some time to come.

Table 2: Some arithmetic implications of rising government indebtedness

	Debt-to-GDP ratios (%)						
Proportion of GDP (%)	**0**	**20**	**40**	**60**	**80**	**100**	**120**
DEFICIT *	0.0	0.9	1.8	2.7	3.6	4.5	5.4
DEBT SERVICE							
r = 3.5%	0.0	1.1	2.2	3.3	4.4	5.5	6.6
r = 5.0%	0.0	1.4	2.8	4.2	5.6	7.0	8.4
r = 6.5%	0.0	1.7	3.4	5.1	6.8	8.5	10.2
*TAXES NET OF TRANSFERS***							
r = 3.5%	22.0	22.2	22.4	22.6	22.8	23.0	23.2
r = 5.0%	22.0	22.5	23.0	23.5	24.0	24.5	25.0
r = 6.5%	22.0	22.8	23.6	24.4	25.2	26.0	26.8
*GOVERNMENT EXPENDITURES ON GOODS AND SERVICES****							
r = 3.5%	22.0	21.8	21.6	21.4	21.2	21.0	20.8
r = 5.0%	22.0	21.5	21.0	20.5	20.0	19.5	19.0
r = 6.5%	22.0	21.2	20.4	19.6	18.8	18.0	17.2

* This arithmetic assumes a long-run growth for real GDP of 2.5 per cent and a rate of inflation of 2.0 per cent.

** Government expenditures on goods and services are held constant.

*** Taxes net of transfers are held constant.

are essentially the same as those for taxes net of transfers reported in the third panel, except that the direction is reversed. Higher debt means lower spending on goods and services, and again the adjustments are modest in comparison to the rate at which debt-service costs rise with the debt-to-GDP ratio.

To put this arithmetic in sharper perspective, it may be useful to provide some numbers. For example, the increase in taxes net of transfers that is required to sustain a debt-to-GDP ratio of 60 per cent, relative to a ratio of 20 per cent (the level in 1983), is between 0.4 and 1.6 per cent of GDP, depending on the interest rate assumed. In the intermediate case with r = 5.0 per cent, tax revenues from all sources would have to rise by 1.0 per cent of GDP. For 1993 this would have amounted to an extra $7 billion of tax revenues. These calculations reflect long-run or steady-state effects, and therefore ignore the paths of taxes, expenditures and deficits between steady states. For example, if the debt-to-GDP ratio rises from 20 to 60 per cent, there could be a temporary decline in taxes net of transfers or a temporary increase in expenditures on goods and services. It is only gradually, as the debt builds up, that taxes would have to rise or primary expenditures fall to support the growing debt service expense.

The results in Table 2 are *arithmetic* in the sense that they hold "all other things constant." In particular, they assume that the level of government debt does not itself affect the level or growth rate of GDP, the real interest rate or the rate of inflation – the other important determinants of the government's long-run budget constraint. In addition, the focus of the arithmetic is quite narrow; it considers only the impact of higher debt levels on the government's budget constraint and says much less about its impact on households or firms.

Under the special conditions of the Ricardian Equivalence Hypothesis (REH), the arithmetic of Table 2 also provides the *economics* of debt and deficits for the case with constant government expenditures as a proportion of GDP. According to the REH, consumers recognize that higher government debt implies higher future taxes and therefore they save the interest on their holdings of the government debt and use the additional interest income to pay those higher taxes. In other words, public dissaving associated with higher debt levels is offset by higher private saving, so national saving and thus national wealth, the real interest rate, real output and inflation are all unaffected by the level of government debt.

The basic insight of the REH – that consumers take account of the link between debt and taxes – is an important one, but the strict debt-neutrality prediction of the REH rests on several unrealistic assumptions. In particular, it assumes that everyone has equal access to capital markets, that borrowing and lending rates are equal, that consumers have an infinite horizon, that governments have access to non-distortionary taxation and that there is no uncertainty. In our view, the conditions of the REH and its debt-neutrality prediction do not provide a good characterization of real-world economies. This being the case, the arithmetic of Table 2 provides only part of a complete analysis. A complete analysis must factor in the real effects of government debt and the implications for the economic welfare of Canadians. Towards this end, we turn to a dynamic macro simulation model in which government debt does affect real activity.

3 The real effects of government debt

3. 1 Overview of QPM

As mentioned earlier, our simulation analysis of the effects of government debt uses QPM, a new model of the Canadian economy used at the Bank of Canada for economic projections and for policy analysis. QPM reflects an attempt to meld the rigorous theoretical structure necessary for modern policy analysis with the practical requirements of a model designed to support economic projections. In constructing QPM, Bank staff broke from past practice in moving away from traditional, single-equation econometric techniques that were featured in models of earlier vintages. QPM is calibrated, not estimated. We nevertheless consider QPM to be very much an empirical macro model. The data have been used extensively to provide stylized facts for the calibration. These stylized facts include more than the properties revealed by standard descriptive statistics. For example, estimated vector autoregressive models have been used to establish what short-run impulse response patterns and cyclical properties are consistent with the data. Empirical results from other research have also been used in selecting some key parameters.

At the heart of QPM is a steady-state model (see Black et al. 1994). The steady-state model describes the determinants of the long-term choices made by profit-maximizing firms and overlapping generations of consumers, given the policy choices of the fiscal and monetary authorities, all in the context of an open economy with important relationships with the rest of the world. The economic behaviour of these agents, given their long-run budget constraints, and the market-clearing conditions of an open economy determine the long-run equilibrium or steady state to which the dynamic model converges.

The dynamic model has several important features. First, agents in QPM are forward-looking. In particular, they act based on intertemporal optimization, conditioned by expectations that are forward-looking, albeit not fully model-consistent. The evolution of expectations plays a key role in the overall dynamic response to shocks. In addition, adjustment of both quantities and prices is presumed to be costly, so there are also "intrinsic" elements to the model's dynamic properties.

Second, the model provides a complete and consistent solution for all stocks and flows. When a shock affects the level of a stock, this often creates the necessity for cycles in flow variables, which can be an important contributor to overall dynamics. Thus, for example, if the shock entails a move to a higher stock of debt relative to GDP, the process of increasing the debt along the transition path will typically involve a short-run deficit which exceeds the steady-state deficit that is consistent with the new higher debt-to-GDP ratio. This higher short-term deficit must arise from temporarily higher spending or lower taxes, and these factors will have important short-term effects on the macro economy. Eventually, however, the higher debt service means an increase in taxes or a reduction in primary expenditures in order to respect the government's long-run budget constraint.

Third, monetary policy is conducted through a forward-looking policy rule that calls for the monetary authority to adjust its policy instrument in such a way as to bring expectations into line with the targeted inflation rate.[12] The instrument of monetary policy in QPM is the short-term interest rate, which has its influence on spending through the slope of the yield curve. Movements in the short-term nominal interest rate also affect the nominal exchange rate and hence import prices and inflation, through an uncovered interest parity condition. Inflation is also influenced directly by the state of excess demand and by expectations about future inflation.

The nature of the monetary policy rule is such that achieving the target inflation rate is subject to constraints, including a penalty on large movements in the policy instrument in any one period. Another constraint is the underlying dynamic structure of the model, which includes both lags between adjustment in the policy instrument and changes in aggregate demand and lags between changes in aggregate demand and the response of prices. Thus, the horizon over which the monetary authority can achieve its objective will vary with the disturbances under study. In stark contrast to many other models used for policy analysis, it makes no sense in QPM to conduct policy experiments with the monetary instrument held fixed. Pegging the monetary instrument is not generally feasible except in the very short run, because unless the monetary control variables adjust to provide a nominal anchor for expectations, the solution cannot converge to a steady state. We consider dynamically unstable simulations to be uninterpretable and potentially very misleading.

Fiscal policy in QPM, like monetary policy, is characterized by a set of objectives that are consistent with achieving a sustainable equilibrium. In

12. There is no long-run trade-off in the model between inflation and output, so monetary policy does not influence the real economy in the long run. One implication of this feature is that there are no long-run benefits in QPM to targeting a low rate of inflation. This is viewed as a temporary simplification to the model, while other research (such as Black et al. 1994) attempts to better determine the magnitude of the long-run effects of inflation on the level of output.

particular, the fiscal authority picks a target level of government expenditures on goods and services, and a target debt-to-GDP ratio. Taxes net of transfers and the deficit adjust to achieve these targets.[13] On the tax side, the model includes both direct and indirect taxes, and the fiscal reaction function requires direct taxes to adjust so that the debt-to-GDP ratio converges smoothly on its targeted rate. In addition, consistent with the historical stylized facts, government expenditures on goods and services are modelled as slightly procyclical. Taxes and government spending, like interest rates, affect aggregate demand and prices. Policy analysis must therefore take into account the interaction between fiscal and monetary policy.

3. 2 Real effects of government debt in QPM

In QPM, government debt has real effects primarily for two related reasons. First, economic growth is fuelled by the birth (or immigration) of new consumers. Current consumers therefore act knowing that they will not be responsible for the full tax burden of servicing the debt, since some portion of this burden will automatically be assumed by future generations. Consumers also act knowing that they are mortal and may therefore not be around to pay even a reduced share of future taxes associated with current deficits.[14] Thus, changes in government debt levels alter the real choices of households. Second, in the context of an open economy, there are consequences for net indebtedness to foreigners, consequences that have an impact on the real exchange rate and the level of output.

13. Although picking a short-run target for the deficit-to-GDP ratio may be a useful intermediate objective, the real equilibrium of the economy depends on the debt-to-GDP ratio. Hence targeting the deficit-to-GDP ratio will not generally yield a unique steady-state solution, especially in an economy subject to shocks. Moreover, targeting a deficit ratio that implies an equilibrium level of debt that is not close to the initial level will generally result in extremely long periods of adjustment.

14. At a formal level this is accomplished using the uncertain lifetimes model of consumer behaviour developed by Blanchard (1985) and Frenkel and Razin (1987). See Black et al. (1994) for details.

To be concrete, let us consider the case of a permanent increase in the level of government debt. To bring about the rise in the stock of debt in the first place, the government must operate temporarily with a much higher deficit than in the steady state. Suppose, further, that this is brought about through temporarily lower taxes, with government expenditures held constant. Note that these tax cuts must be temporary, since in the new steady state with more government debt, taxes will be higher to support the higher debt service. However, current generations expect that some of the burden of higher future taxes will fall on future generations. As a result, for current generations the present value of the rise in disposable income during the temporary period with lower taxes is greater than the present value of the fall in disposable income thereafter. Households therefore increase their consumption in the short run rather than save all the additional disposable income they receive. This rise in consumption increases imports and reduces exports as more output is absorbed domestically. The trade balance therefore deteriorates, and since Canada is a net international debtor, this results in a rise in net foreign liabilities. With more foreign liabilities, the steady-state trade surplus must be larger to cover the additional interest payments on the foreign debt. To achieve this larger trade balance surplus, a larger share of domestic output will have to be sent to foreigners, leaving less output available for domestic use. Consumption is therefore reduced in the long run as the higher taxes and foreign debt service are absorbed. The effect of raising the level of government debt is therefore to raise consumption temporarily at the cost of a permanently higher level of foreign indebtedness and a subsequently permanently lower level of consumption.

Some guidance as to the quantitative importance of these effects is provided in Table 3, which reports steady states predicted by QPM for different debt-to-GDP ratios. The steady-state results set aside dynamic issues of the transition from one steady state to another, allowing us to focus on the long-run effects of debt. We will return to the issue of dynamics. For these illustrative calculations, the model is calibrated so that with a net debt-to-GDP ratio of 60 per cent, the ratio of net foreign liabilities to GDP is 46 per cent, as observed in 1993. Consistent with the arithmetic of Table 2, the long-run real growth rate is assumed to be 2.5 per cent,[15] and the real interest rate is set to 5 per cent as in the "intermediate" case. Government expenditures on goods and services are set to 22 per cent of GDP when the debt-to-GDP ratio is 60 per cent. For the simulations, the level of government expenditures on goods and services is held fixed, and direct taxes and the deficit adjust endogenously to sustain the alternative debt-to-GDP ratios. The top panel of Table 3 reports percentage change results for key macro variables relative to the steady state, which has a debt-to-GDP ratio of 60 per cent. In the bottom panel of Table 3, the results are reported in levels as a percentage of GDP.

Consider, first, the effects of increasing the debt-to-GDP ratio above its current level of 60 per cent of GDP. Increasing the debt-to-GDP ratio from 60 to 80 per cent results in an almost one-for-one rise in net foreign liabilities from 46 to 67 per cent of GDP. With both higher taxes and a larger foreign debt, consumption is 1.3 per cent lower in the higher-debt steady state. A small real exchange rate depreciation is required to increase exports and lower imports to achieve the necessary rise in the trade surplus. This depreciation increases the cost of capital, because a substantial proportion of capital is imported. The capital stock therefore falls and, with less capital to work with, the economy produces less output. The effects on output and the capital stock are relatively small, however, compared with the decline in consumption. The reason is that, with larger foreign liabilities, domestic consumers must pay more of their output to foreigners. Thus, while the level of government debt is predicted to have a relatively small impact on output,

15. The aggregate growth rate of 2.5 per cent reflects 1 per cent population growth with the remainder coming from productivity growth.

Table 3: Steady-state effects of government debt in base QPM

	Debt-to-GDP ratios (%)						
	0	**20**	**40**	**60**	**80**	**100**	**120**
Percentage change from initial steady state with debt-to-GDP ratio of 60 per cent							
Output	0.7	0.5	0.2	0.0	-0.2	-0.4	-0.7
Consumption	4.0	2.7	1.4	0.0	-1.3	-2.6	-3.9
Exports	-2.0	-1.3	-0.7	0.0	0.7	1.3	2.0
Imports	3.7	2.4	1.2	0.0	-1.2	-2.3	-3.4
Capital stock	2.1	1.4	0.7	0.0	-0.6	-1.3	-1.9
*Real exchange rate**	-2.3	-1.5	-0.8	0.0	0.8	1.5	2.3
Level as a proportion of GDP (%)							
Deficit	0.0	0.9	1.8	2.7	3.5	4.4	5.3
Net foreign liabilities	-17.8	3.5	24.7	46.0	67.3	88.5	109.8
Interest payments to foreigners	-1.3	0.2	1.8	3.3	4.8	6.3	7.8
Taxes net of transfers	21.6	22.2	22.7	23.3	23.9	24.4	25.0

* The exchange rate is measured relative to an index of the currencies from the rest of the G-7 and is defined in terms of the price of foreign exchange. A rise in the real exchange rate therefore constitutes a real depreciation.

the impact on living standards, as measured by consumption, is much larger. In present value terms, a permanent decline in consumption of 1.3 per cent amounts to the equivalent of a drop in consumption of 52 per cent in one year.[16]

The predicted long-run effects of reducing the debt-to-GDP ratio can be seen in Table 3 by moving to the left from the column with a debt-to-GDP ratio of 60 per cent. Compare, for example, the steady states with debt-to-GDP ratios of 40 and 60 per cent. The debt-to-GDP ratio in Canada was 40 per cent as recently as 1990. With lower government debt, taxes net of transfers are reduced by 0.6 percentage points, but net foreign liabilities are considerably lower. With

16. The discount rate here is r-x = 2.5 per cent as in the simulation results reported in Table 3.

lower foreign debt, less domestic output is needed to pay interest to foreigners, so consumption rises by 1.4 per cent. We obtain considerably larger increases in steady-state consumption from reducing the debt level further. For example, with a debt-to-GDP ratio of 20 per cent – the observed ratio in Canada in 1983 – consumption is 2.7 per cent higher than with a debt to GDP ratio of 60 per cent. In present value terms, the predicted consumption loss in allowing the debt ratio to change permanently from its value in 1983 to its value in 1993 amounts to more than one full year's consumption.[17]

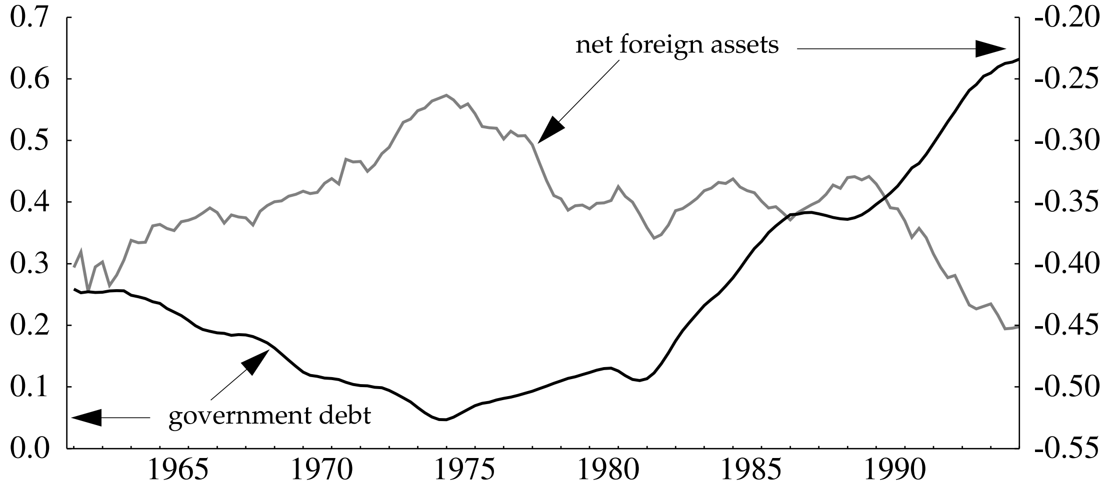
To summarize, the long-run results highlight the link between government indebtedness and net international indebtedness. This channel is also clearly evident in recent Canadian data. While there are many shocks that affect the current account and thus net foreign assets, Figure 1 reveals a clear negative correlation between net government debt and net foreign assets (both as a proportion of GDP), particularly in recent years. As rising government debt has increasingly absorbed domestic savings, private borrowing from abroad has increased, and with it, interest obligations to foreigners.

3. 3 Some extensions

These steady-state results from the base model illustrate that intergenerational transfers resulting from changes in the level of government debt have important real implications. There are, however, several other potentially important channels through which government debt affects economic activity in the economy that are not included in the base version of QPM. These arise from a number of sources.

17. It is also worth noting that simpler and theoretically tighter versions of the model typically yield larger steady-state effects of government debt. Black et al. (1994) find that a one-good version of the simple overlapping generations model calibrated to Canadian data predicts that the consumption costs of government debt are about twice as large as those in QPM, and Macklem's (1993) two-sector version of this simple model yields a consumption cost that is 1.2 times the QPM estimate.

Figure 1: Net government debt and net foreign assets in Canada as a proportion of GDP



A temporary deficit-financed tax cut will stimulate consumption in the short run if some households consume out of current income (because they are unable to gain access to capital markets owing to inadequate collateral) or if governments can borrow at better rates than consumers. Recognizing that future incomes are uncertain can also disturb debt neutrality. Consumers may give more weight to an increase in current disposable income than to an uncertain decline (of similar present value) in future disposable income.

Not only does debt affect aggregate demand, but as is being increasingly realized, government debt affects the supply side of the economy as well. In particular, higher debt levels require higher tax rates to be sustained, and taxes affect economic activity by driving a wedge between the price the seller receives and price the buyer pays. This wedge imposes an efficiency cost on the economy that is larger the higher taxes are. In labour markets, for example, most studies find that the effect of higher taxes is to reduce desired labour supply, and the disincentive effects of taxation are larger the higher marginal tax rates are (see Hausman 1985). More generally, estimates of the welfare losses resulting from the distorting effects of taxes are typically substantial. Most estimates of the marginal welfare cost of taxes per dollar of added revenue for the United States range from about 15 to 60 cents, with median estimates of 30 to 45 cents (see Browning 1976, 1987 and Ballard, Shoven and Whalley 1985). Estimates for Canada reported by Thirsk and Moore (1991) are in the high end of this range, and more recent estimates by Dahlby (1994) suggest that the marginal excess burden of taxation may be above 60 cents per dollar of revenue. The higher estimates for Canada reflect both the higher marginal tax rates and greater progressivity of the tax system in this country. Moreover, if results for more highly taxed economies such as Sweden's (see Hansson and Stuart 1985) are taken to be indicative, the marginal welfare costs of taxes in Canada can be expected to rise if taxes are increased from current levels.[18]

Higher debt and deficits also create uncertainty, the price of which is reflected in risk premiums. Both casual observation and more formal econometric evidence suggest that the larger government debt and deficits are relative to the size of the tax base, the higher is the real interest rate that governments must pay.[19] In the 1980s and 1990s, many governments have seen the risk premium demanded by the market on their debt increase as their debt levels have risen relative to their revenue bases. This has also been reflected in bond-rating downgrades, which can have the additional effect of reducing the potential

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18. The marginal welfare costs cited do not take into account the additional compliance costs and tax evasion associated with higher taxes. Usher (1986) has argued that such costs should be included when calculating the marginal welfare cost of public funds. Vaillancourt (1989) estimates that in 1986 the sum of all administrative and compliance costs of the personal income and payroll tax system in Canada was $5.5 billion, which implies an average cost of 6.9 per cent per unit of revenue, but we are not aware of estimates of the marginal cost. Regarding the importance of tax evasion, there is less evidence owing to the obvious problem of collecting reliable information. A recent study by Fortin et al. (1994), based on a survey conducted in Quebec City, suggests that taxes do distort labour-market activities away from the regular sector to the underground sector, although the distortion has been small for the average worker.

19. Recent empirical evidence includes that of Alesina, Prati and Tabellini (1990, 1993), Cottarelli and Mecagni (1990), Goldstein and Woglom (1992), Bayoumi, Goldstein and Woglom (1994), and Missale and Blanchard (1994). These authors stress that while default is very unlikely in most cases, larger debts may raise concerns among lenders that governments may decide to augment their traditional sources of revenue with new forms of taxation such as surprise inflation, capital levies, capital controls or the nationalization of foreign-owned assets, and lenders will demand a premium to be compensated for these risks.

market for the debt, since some lenders are either unable (due to institutional constraints) or unwilling to hold debt rated below a certain level. At the federal level, both these effects have been relatively small to date, as the debt rating remains relatively high, but for some provincial governments, such as those of Newfoundland and Saskatchewan, these effects have been more important.[20]

In an effort to assess the quantitative importance of at least some of these supply-side channels through which debt may have real effects, QPM is extended in two directions. The first extension allows for the distortionary effects of personal income taxes on labour supply. This is accomplished by extending the consumer decision in the steady-state model to include consumer preferences for work and leisure.[21] In this setting, an increase in personal income taxes will lower the after-tax real wage, thereby lowering the opportunity cost of leisure and causing consumers to substitute away from labour-market participation and towards leisure.

The top panel of Table 4 reports the impact of allowing personal income taxes to influence labour supply. As expected, this extension magnifies the real effects of increases in the level of government debt, since the higher taxes required to sustain higher debts reduce labour supply and hence equilibrium employment, but the effects seem to be of relatively modest size. If the debt-to-GDP ratio changes from 60 to 80, consumption falls 1.5 per cent, as compared with a drop of 1.3 in base QPM. Moreover, the impact is even smaller in terms of consumer welfare, since leisure rises as consumers substitute away from work. The modest

20. See Boothe (1993) for a review of the recent experience in Saskatchewan.

21. Formally, we incorporate the endogenous labour supply decision into the steady state of QPM by defining the constant-elasticity-of-substitution utility function in terms of a composite good that is Cobb-Douglas in consumption and leisure. Base QPM is therefore a special case of this extended version with the Cobb-Douglas share weight on leisure set to zero. In the extended version, the share weight on leisure is chosen so that consumption falls by 35 cents when the revenue from personal income taxes is increased by $1.00 (and then given back to consumers in the form of a lump sum transfer). Since the welfare effect of this fall in consumption is partly offset by a rise in leisure, this calibration implies a marginal excess burden of income taxation that is at the low end of the range of estimates cited above, and is consistent with the estimates obtained by Rose and Selody (1985) for Canada based on data ending in 1981.

impact of the distortionary effect of taxation reflects two things. First, taxes do not have to rise that much to support higher steady-state debt-to-GDP ratios – personal income taxes rise only 1.1 percentage points when the debt-to-GDP ratio moves from 60 to 80. Second, the marginal excess burden of taxation that is assumed in the model is relatively modest; less conservative assumptions would produce larger effects.

The second extension to the base model attempts to incorporate the impact of the debt and deficits on risk premiums and uncertainty. Two types of effects are included in the model: a level effect to capture the impact of the level of the debt-to-GDP ratio on the risk premium, and a direction effect that captures the idea that the risk premium depends on the direction the debt-to-GDP is moving as well as its current level. These effects are calibrated based on evidence reported by Alesina et al. (1993) for 12 OECD countries for the period 1979 to 1989. Consistent with the evidence of Alesina et al., the level effect is calibrated so that a one percentage point increase in the debt-to-GDP ratio has the rather modest effect of raising the risk premium by 1.7 basis points when the debt-to-GDP ratio is "high," which based on their sample is taken to be above 50 per cent. This specification captures the non-linear nature of the risk premium, although a more appealing specification (as in Bayoumi, Goldstein and Woglom 1994) would allow for the possibility that the risk premium may increase at an increasing rate with the debt-to-GDP ratio.[22] The direction effect is calibrated to be 6.6 basis points per percentage point change in the debt-to-GDP ratio. In the steady state, the debt-to-GDP ratio is constant so this direction component is zero, but along the dynamic adjustment path it will augment the first term if the debt-to-GDP ratio is rising.

22. At some point, some lenders may decide not to make further loans at all – the risk premium would then become very large.

Table 4: Steady-state effects of government debt in extended QPM
(% change from a net debt-to-GDP ratio of 60 per cent)

	Debt-to-GDP ratios (%)						
	0	**20**	**40**	**60**	**80**	**100**	**120**
Distortionary taxation of labour income							
Output	1.1	0.7	0.4	0.0	-0.4	-0.7	-1.1
Consumption	4.7	3.1	1.6	0.0	-1.5	-3.0	-4.5
Employment	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.5
Risk premium on government debt							
Output	0.7	0.5	0.3	0.0	-0.3	-0.7	-1.2
Consumption	4.4	3.0	1.6	0.0	-2.1	-4.5	-7.2
Distortionary taxation of labour income and a risk premium on debt							
Output	1.2	0.8	0.4	0.0	-0.6	-1.2	-2.0
Consumption	5.0	3.4	1.8	0.0	-2.4	-5.2	-8.4
Employment	0.5	0.3	0.2	0.0	-0.3	-0.6	-0.9

This risk premium is added to the base interest rate for government and for net foreign borrowing.[23]

The separate impact of allowing government debt to affect risk premiums is reported in the second panel of Table 4; the third panel reports the combined impact of distorting taxes and risk premiums. The impact of the risk premium is to increase the burden of government debt above a debt-to-GDP ratio of 50 per cent. Moving from a debt-to-GDP ratio of 60 to 80, for example, the fall in steady-state consumption is predicted to be 2.1 per cent with a rise in the risk premium of 34 basis points. The effect of the risk premium grows as debt is increased further.

23. The risk premium is applied to net foreign liabilities because their existence is largely driven by the need to finance the government debt. Indeed, as shown in Table 3, the model predicts that if there were no government debt, Canada would be a net foreign creditor. In the model, all government debt is assumed to be held by domestic residents, but they effectively sell much of the debt to foreigners by borrowing from abroad to pay for it.

Doubling the debt-to-GDP ratio from 60 to 120 per cent of GDP is predicted to raise the risk premium by 102 basis points, and results in a decline in consumption of 7.2 per cent as compared to 3.9 per cent in base QPM. With a full accounting of the non-linear response of the risk premium, the impact of higher debt levels would likely be considerably larger.[24] The combined effect of the risk premium and distortionary personal income taxes is to increase the consumption cost of government debt even further – consumption falls by 2.4 per cent in this version of the model when the debt-to-GDP ratio moves from 60 to 80 per cent.

These results suggest that even modest assumptions regarding the size of some of the supply-side effects of debt can increase estimates of the long-run burden of debt considerably. Note, in particular, that the combined impact of alternative channels will tend to be larger than the sum of their individual effects because they tend to reinforce each other in general equilibrium. In Table 4, the effects of distortionary taxation are more pronounced when the level of government debt is assumed to affect risk premiums.[25] It is also worth stressing that these are only the steady-state effects. The impacts of distortionary taxation and risk premiums can be considerably larger along the dynamic adjustment path. Finally, other real-world debt non-neutralities could also be incorporated into the analysis. For example, to this point we have assumed that higher levels of government debt do not affect domestic interest rates for *private* borrowing. Casual observation suggests, however, that larger debts, by increasing aggregate uncertainty, raise all interest rates. Allowing for this sort of effect in QPM would

24. At debt-to-GDP ratios that are considerably above 50 per cent, a risk premium of 1.7 basis points per percentage point increase in the debt-to-GDP ratio is almost certainly too low, but since there are few historical observations with debt-to-GDP ratios considerably above 50 per cent, it is difficult to infer reasonable parameter values with which to calibrate such a non-linearity.

25. The easiest way to see this is to compare the effects on consumption of doubling the debt-to-GDP ratio from 60 to 120 per cent. With exogenous risk premiums, the steady-state decline in consumption increases by 0.6 percentage points from 3.9 per cent in base QPM to 4.5 per cent when the distortionary effects of taxation are added. When risk premiums are allowed to vary with the debt level, the impact of distortionary taxation is twice as large – the fall in consumption is 8.4 per cent when distortionary taxes and risk premiums are combined, as compared with 7.2 per cent when the risk-premium effect alone is allowed for.

mean that higher government debt levels would raise the cost of capital, thereby discouraging investment and reducing the economy's productive capacity. However, in the absence of empirical evidence as to the size of this effect, we leave this for future work.

3. 4 Dynamic effects of debt and deficits

Before turning to the effects of debt and deficit reduction, it is useful to outline the dynamics underlying the steady-state experiments considered above in more detail. The dynamic adjustment path between two steady states depends, of course, on the shocks that precipitated the rise in debt. Since prices and wages are not perfectly flexible and since expectations play an important role in determining behaviour, the reaction function of the central bank will also influence the economy's dynamic path in an important way.

We consider a scenario where the fiscal authority cuts taxes net of transfers temporarily and finances the revenue shortfall by running a larger deficit. The economy is initially in a steady state with a debt-to-GDP ratio of 60 per cent. Given the equivalence of taxes and (the negative of) transfers in the model, this shock can be interpreted either as a temporary tax cut or a permanent rise in transfers that is not initially covered by higher taxes. Here and throughout this paper, we take as given that monetary policy is aimed at maintaining inflation at 2 per cent – the mid-point of the 1 to 3 per cent announced target range for inflation.

The simulations use an augmented version of QPM that incorporates the effect of government debt on risk premiums. Labour supply, however, is left exogenous, so income taxes do not affect the labour-leisure choice.[26] The results are summarized by Figures 2a. to 2l. (pp. 32-33) where the solid lines depict the

26. Although we extended the steady state of QPM to incorporate an endogenous labour supply decision, further work is required to integrate an intertemporal labour-leisure choice into the full dynamic model.

dynamic implications of the debt accumulation for key macro variables, either as percentage deviations from the original steady state or control path, or as a percentage with the control path also shown.

The short-term tax cut (or transfer increase) is substantial, particularly considering that in the long run the tax rate must rise; the net tax rate falls from a steady-state level of 19.9 per cent to a low of 17.9 per cent in year five, and then rises to its new steady state of 21.7. This net tax cut is sufficient to cause the debt-to-GDP ratio to rise to 70 per cent in six years, and to 78 per cent in 10 years, so that the average increase in the debt-to-GDP ratio is 1.8 percentage points per year. When compared with Canada's experience in the 1980s, this is a relatively modest pace of debt accumulation.

The predicted impact of the fiscal shock is to raise consumption to a peak of about 5 per cent above its initial steady-state level by the fifth year. This consumption boom is absorbed largely through higher imports and lower exports, so the impact on aggregate demand is relatively modest – excess demand in the goods market reaches only about 0.5 per cent at year four of the scenario and employment rises by only 0.4 per cent at the same date. This modest impact on aggregate demand reflects the fact that, starting from a state of full capacity, the consumption boom also results in incipient inflationary pressures and precipitates a considerable tightening of monetary conditions. In the first year short-term nominal interest rates increase 140 basis points; thereafter there is still more tightening together with higher inflation, so that the short-term rate rises further to reach a maximum of 630 basis point above control in year five. Higher interest rates result in a sharp exchange rate appreciation; the real value of the dollar rises by 4.1 per cent by year five before falling off. The resulting erosion of competitiveness causes exports to fall and imports to rise, sending the current account further into deficit and increasing net foreign liabilities.

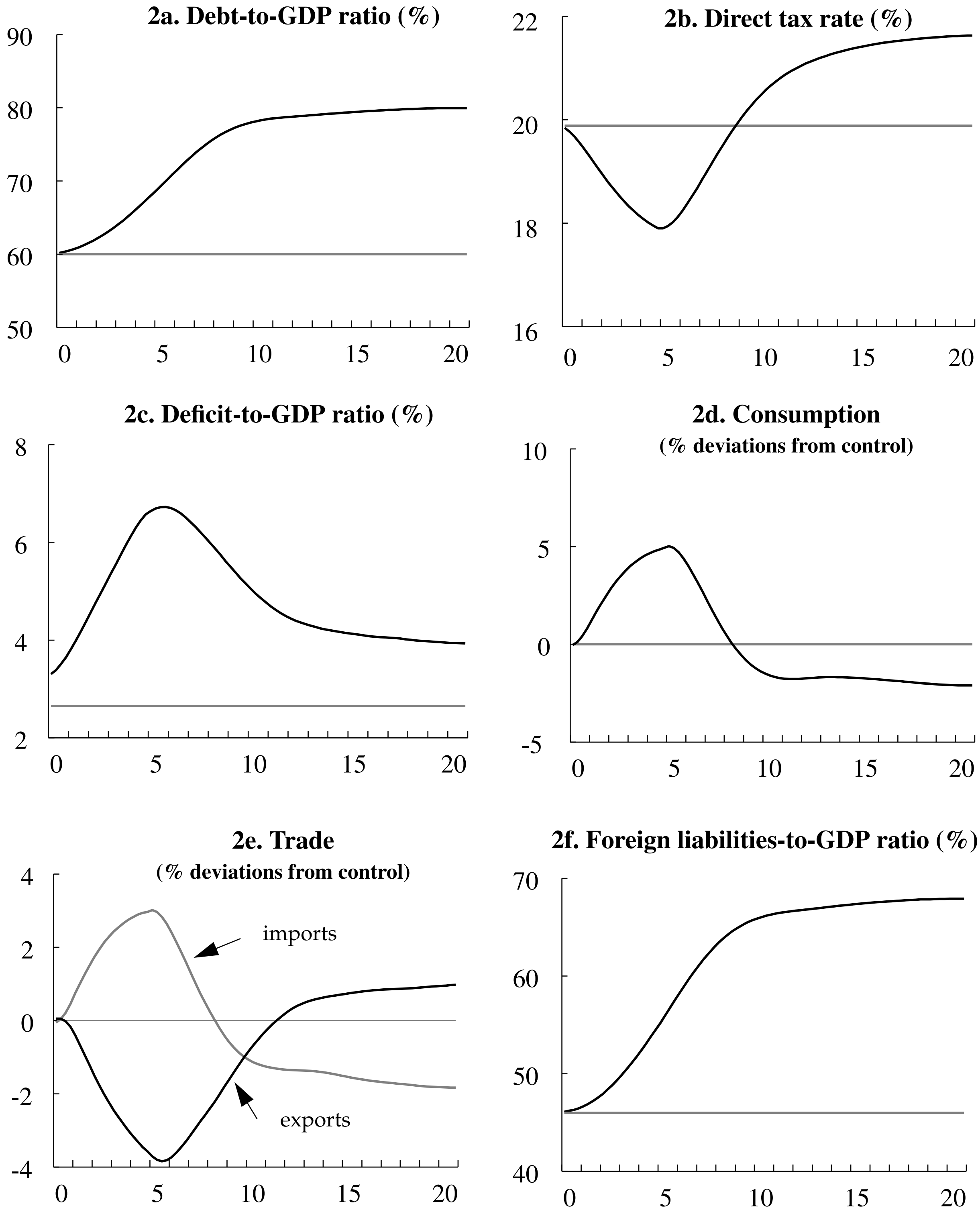
Core inflation, as measured by the year-over-year change in the CPI excluding food and energy, falls initially by about 0.3 percentage points owing to the effects of the appreciation of the currency on import prices. This temporary effect gives way to strong increases in inflation, reaching 1.6 percentage points above the targeted rate in year 7.[27] By this time, higher interest rates and a higher dollar have turned the corner on excess demand so that inflation subsequently returns to the mid-point of its target range.

In terms of a measure of economic welfare, the dynamic results highlight the trade-off of short-run gain for long-run loss. Consumption is above its initial steady state for almost 10 years, but is permanently below the initial steady state thereafter. Since QPM features overlapping generations of mortal consumers, welfare comparisons involve weighing the welfare of one generation, mostly the current one, against the welfare of generations of people not yet born. In the absence of a universally accepted metric to make such judgments, we turn to a simpler comparison – the present value of the consumption gains and losses. In present-value terms, the cumulated changes in consumption result in a net loss equal to 44 per cent of one year's consumption. If we ignore the dynamics and just compare steady states as in the previous section, the loss amounts to 85 per cent of one year's consumption. Thus, taking account of the short-run gain does reduce considerably the net loss relative to the comparative steady-state analysis, but the net consumption loss nevertheless remains substantial.

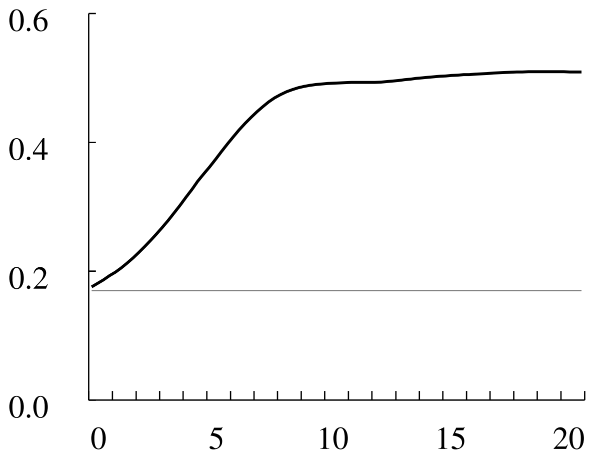
This experiment also highlights the interaction between monetary and fiscal policy. Starting from conditions of full economic capacity, any stimulus from fiscal policy will push up inflation, which is inconsistent with the monetary

27. In QPM, *sustained* moderate excess demand can have large effects on inflation, as small period-by-period effects compound, reinforced by the endogenous response of expectations. These effects are relatively large, in part owing to a non-linear specification of the price equations, such that excess demand has larger effects on inflation than does excess supply of the same absolute magnitude. For empirical evidence on this issue, see Laxton, Rose and Tetlow (1993) and Laxton, Meredith and Rose (1994).

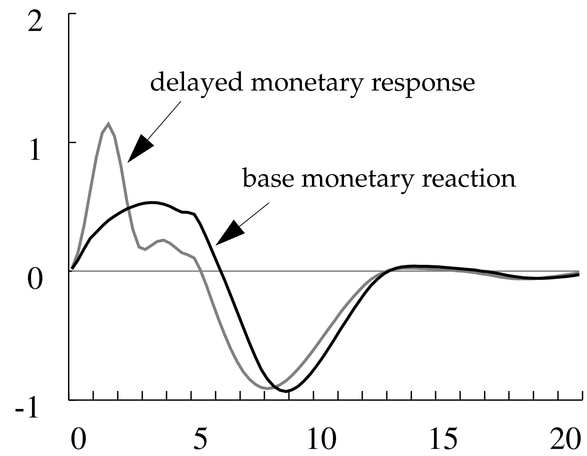
Figure 2
Dynamic effects of a debt increase starting from steady state
(time in years)



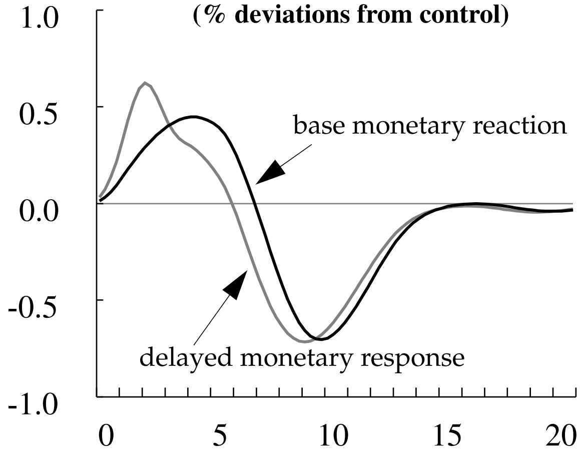
2g. Risk premium on debt (%)



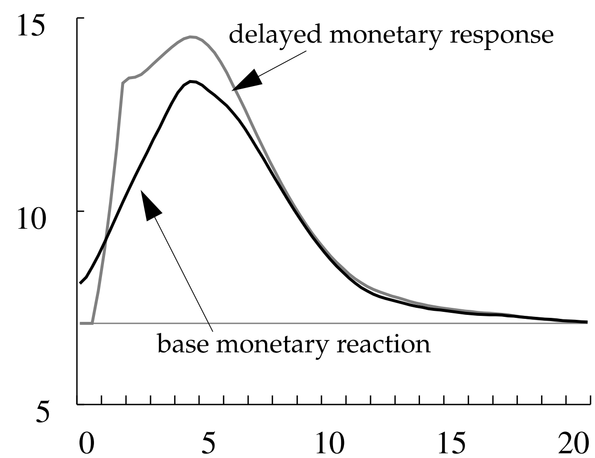
2h. Excess demand (%)



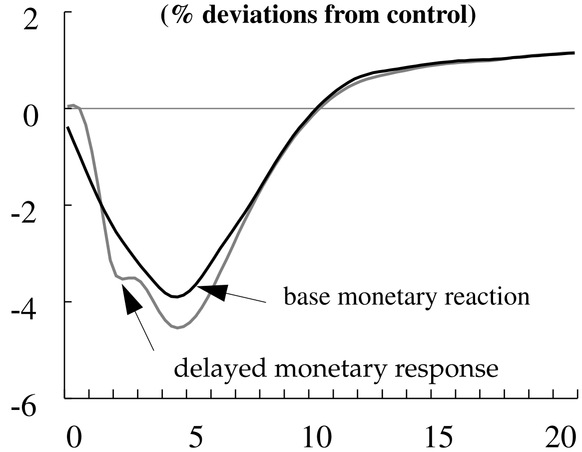
2i. Employment
(% deviations from control)



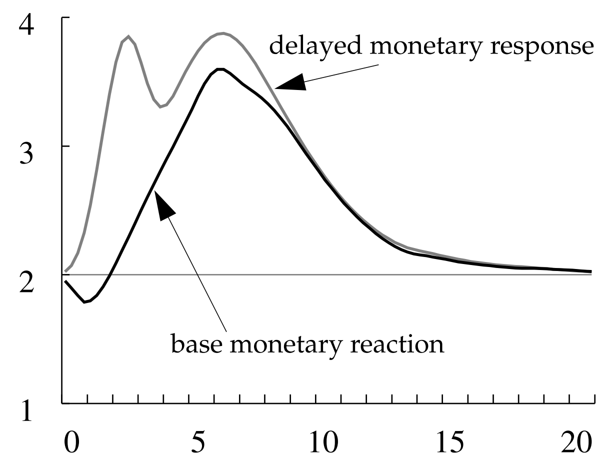
2j. Short-term interest rate (%)



2k. Real exchange rate
(% deviations from control)



2l. Core inflation (%)



objective of maintaining low, stable inflation. The basic monetary reaction function in QPM calls for substantial tightening in monetary conditions to mitigate the inflationary pressures. To explore the impact of the monetary response, we also consider an alternative scenario with an initially more accommodative monetary reaction that trades off temporarily higher inflation for a larger short-run rise in output.[28] The results of this experiment are shown for selected variables by the dashed lines in Figures 2h. to 2l. To summarize very briefly, the initial rise in output is indeed larger than in the basic scenario, but the increase in output is small and it is accompanied by sharply higher inflation over this period. Moreover, in the medium term the temporary gains in output end up being repaid in larger excess supply later on. These results suggest that if the monetary authority is to establish an anchor for inflation, it is better to act quickly and not delay the response to shocks that push inflation away from the target level.

4 Dynamic effects of debt and deficit reduction

The experiments considered above highlight both the long-run effects of the buildup of government debt in Canada and some of the dynamic implications, but in at least one respect they are not very representative of the current situation. The current setting for policy is not one that is well-characterized as a move from one steady state to another – the ratio of government debt to GDP in Canada has been climbing for some time.

To address this reality more closely, we consider two scenarios with a rising debt-to-GDP ratio that we use as control cases, and then we examine the implications of stemming or reversing the rise in debt. The two control cases differ with respect to why the debt-to-GDP ratio is rising. In the first case, debt is rising because of an earlier policy decision to reduce taxes net of transfers. In the

28. The standard monetary response is turned off for two quarters and then phased in over the subsequent three quarters.

second case, debt is rising because of a cyclical downturn that is brought on by an autonomous drop in consumption accompanied by higher interest rates. These two scenarios provide quite different starting points for an analysis of the dynamic effects of fiscal interventions to reduce the growth in the debt. In the first scenario, the economy is initially in a state of excess demand with rising inflation, whereas in the second, debt is rising in the presence of excess supply and falling inflation.

4. 1 Deficit and debt reduction in a state of excess demand

For the scenario that features excess demand, the control solution is very similar to the dynamic simulation considered above (and depicted in Figure 2), with the exception that we start the simulation with a debt-to-GDP ratio of 55 per cent (instead of 60) and increase the target ratio of government debt to GDP by 1 per cent per quarter until it reaches 75 per cent. This means that when the debt-to-GDP ratio hits 60 per cent in year four, it is below its long-run level and rising. The deficit at this point has reached a level more than double the level in the previous control solution, or about 5.3 per cent of GDP, and in the absence of a change in fiscal policy, it will continue to rise for two years, peaking at 6.2 per cent of GDP.

At the point when the debt reaches 60 per cent of GDP, we consider two alternative fiscal interventions. In the first case, which we dub the “moderate” case, the government decides to begin raising taxes (or cutting transfers) to stem the growth of the debt and achieve a long-run debt-to-GDP ratio of 65 per cent. In the second or “more ambitious” case, the government decides to reverse course completely and return to a debt-to-GDP ratio of 55 per cent.

Figures 3a. through 3j. depict the dynamic effects of these two alternative fiscal interventions. Generally speaking, the dotted line represents the control with the thick and thin lines representing the “more ambitious” and “moderate” cases respectively, although in some instances the figures show shock-minus-control results, and thus for those figures the dotted line is the zero line.

From Figure 3a. note that neither intervention involves a particularly rapid adjustment in the stock of debt; in the more ambitious scenario, government debt as a proportion of GDP continues to rise for three more years before finally turning around. From Figure 3b. we see that at the outset the direct tax increases for both scenarios are the same, so in the more ambitious scenario it is the ultimate goal that is ambitious, not the speed at which it is sought. Beyond the short run, direct taxes and the deficit converge smoothly on their lower long-run equilibrium in the moderate case, while in the more ambitious case they must overshoot their long-run levels. This reflects the fact that for the moderate case the ultimate target debt-to-GDP ratio is above the observed ratio at the intervention point, while the more ambitious case calls for an actual reduction in indebtedness. Note, however, that even during the period of overshooting, the government balance does not reach a position of budgetary surplus.

As noted earlier, in the long run, changes in government indebtedness result in nearly one-for-one movements in net foreign indebtedness. Figure 3d. shows that the smooth dynamics of the stock of government debt result in similarly smooth and large movements in net foreign liabilities. The cost of financing these obligations is influenced, in part, by the risk premium, as demonstrated in Figure 3e. Lower levels of government debt lead to a decline in the risk premium, which reduces the cost of financing both government debt and net foreign debt.[29] There is thus both less debt and a lower per-unit cost of servicing that debt.

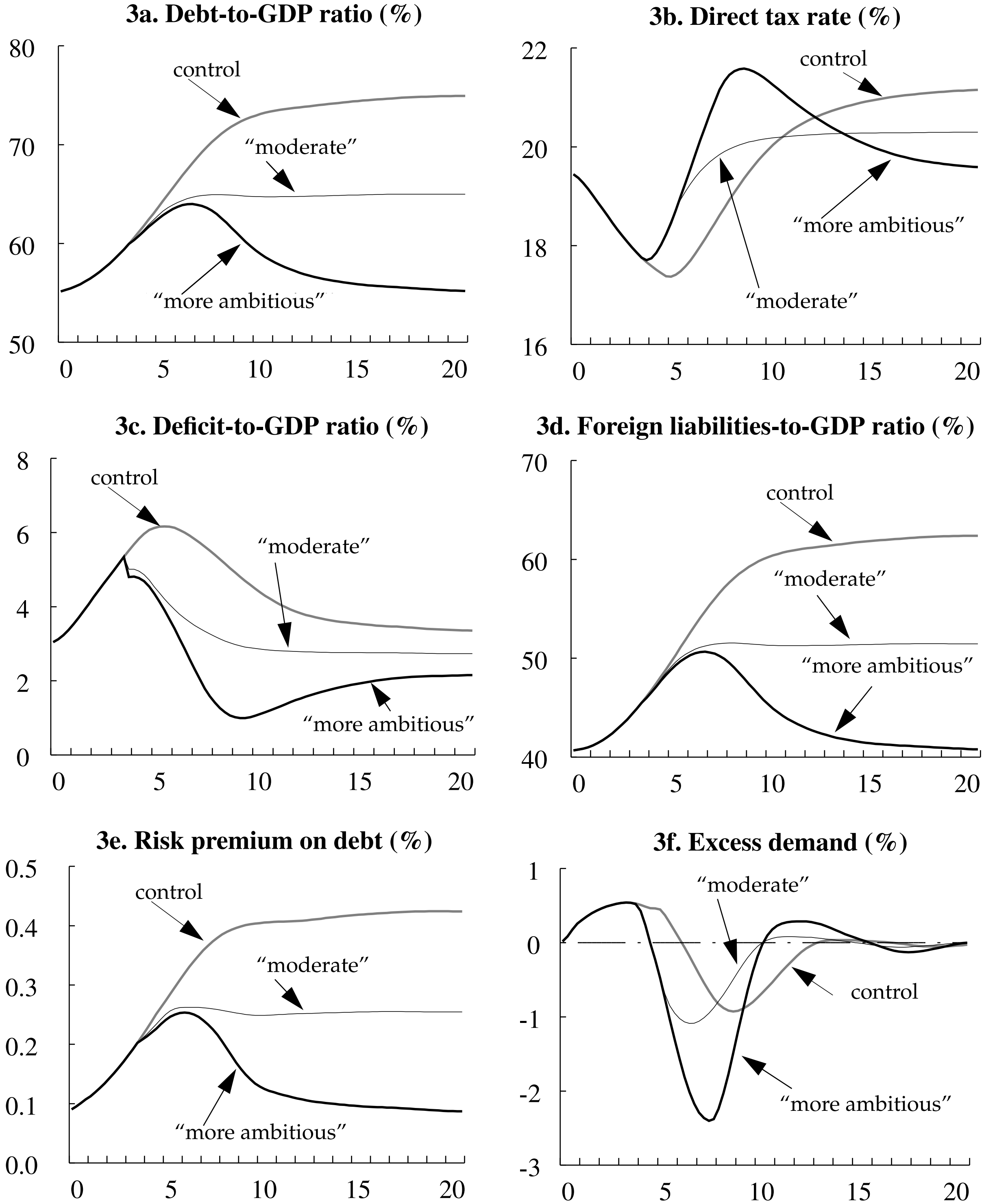
Figure 3.6 shows the state of excess demand under the two scenarios, along with that of the control solution. Note that while there is some loss of output in

29. Recall that the risk premium on government liabilities is identical to the risk premium on net foreign liabilities.

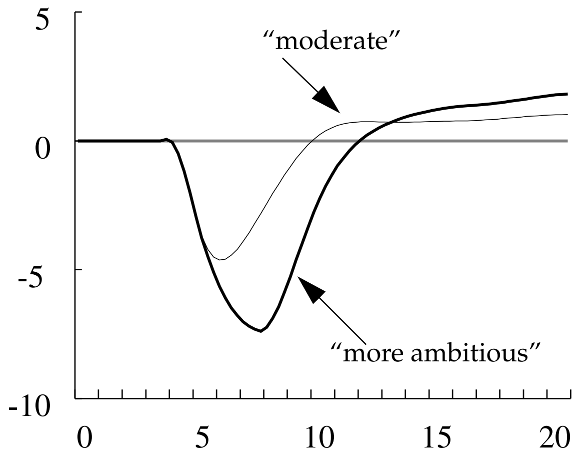
the moderate scenario, there is also a significant output gap in the control case itself. In fact, the cumulative output gap in the moderate intervention scenario is only 0.7 per cent larger than that of the control. The cumulative gap from the more ambitious scenario, however, is 4.4 per cent larger than that of the control case, because of the overshooting required in taxes net of transfers to turn around indebtedness from its starting-point level. Examining these two paths together, we can see that, provided the ratio of government debt to GDP is not reduced from what it is at the starting point, the bulk of what must be paid in lost (excess) demand to cap the expansion of public debt is a price that must be paid in any case simply to reestablish flow equilibrium in the economy. A reduction in the debt-to-GDP ratio comes at a higher short-run cost, but it is worth noting that while output growth slows down considerably in the short run, it never turns negative.

It is worth keeping in mind that these output gaps are by definition deviations from potential output and that in these experiments potential output is changing. This means that the cumulative output gaps provide only part of the story concerning the welfare implications of the fiscal interventions. A better picture of the welfare implications of these interventions is provided by the dynamics of consumption as shown in Figure 3g. In order to decrease, or even decelerate debt accumulation, savings must rise, so that even in the moderate case where the tax rate does not overshoot, there is a substantial short-run sacrifice in consumption that must be borne – consumption reaches 4.6 per cent below control in the moderate case and -7.4 per cent in the more ambitious scenario. Both of these scenarios, however, involve lower levels of public debt and net foreign liabilities than in the control case; this, in turn, implies a reduction in the interest obligations to foreigners, which implies a higher level of consumption in the steady state. Accordingly, consumption eventually rises permanently above control levels. And as one would expect, the more ambitious scenario features

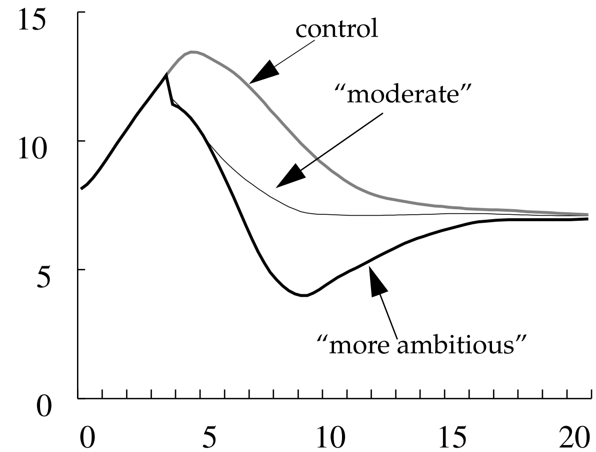
Figure 3
Dynamic effects of debt reduction starting with excess demand
(time in years)



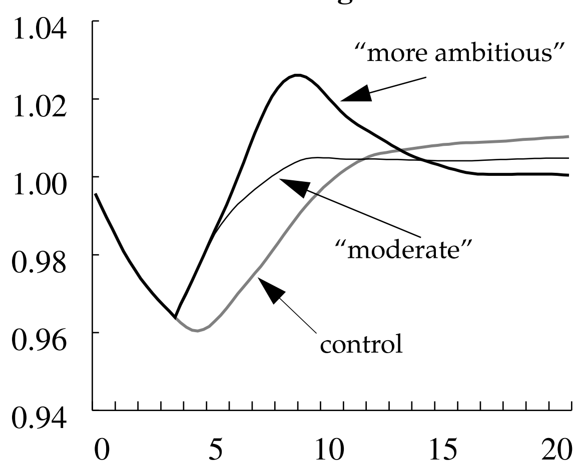
3g. Consumption
(% deviations from control)



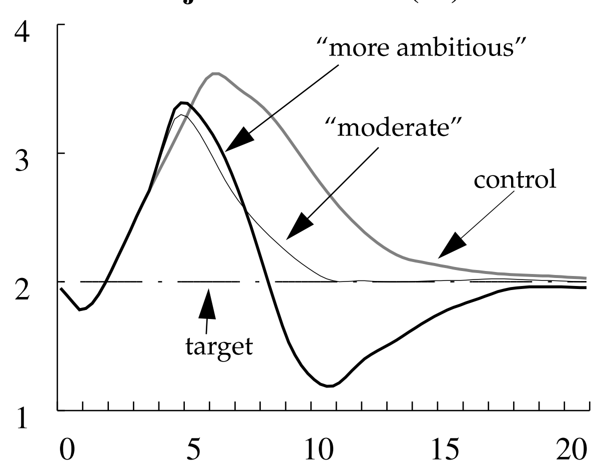
3h. Short-term interest rate (%)



3i. Real exchange rate index



3j. Core inflation (%)



larger and more long-lasting losses in consumption in the short run than does the moderate case, but they are traded off against larger gains thereafter.

These scenarios exemplify quite well the policy dilemma: whether or not to accept short-term losses in consumption that can be quite large in order to benefit from smaller but permanent gains in consumption in the long run. In present-value terms, the net consumption gain under the more ambitious scenario relative to the control case is positive and equivalent to about 32 per cent of a single year's consumer expenditures. The analogous number for the moderate case is 20 per cent.[30] Thus, to the extent that the discounted sum of consumption gains and losses is the appropriate welfare measure, these results suggest that resisting an upward trend in government indebtedness is a welfare-enhancing strategy and that at least some reduction would be more beneficial, at least under the maintained assumptions for these experiments.

What role is the monetary authority playing in all of this? Since the economy is initially in a state of excess demand and inflation is rising, the fiscal tightening helps the monetary authority offset the latent inflationary pressures that are building up. The monetary authority can therefore ease monetary conditions considerably, relative to what they otherwise would have been, and still realize a better inflation performance. As shown in Figure 3h., the declines in interest rates are very similar in the two scenarios in the short run, reaching 310 basis points below control six quarters after the start of the fiscal intervention. Thereafter, the two scenarios diverge. In the moderate case, short-term interest rates converge smoothly to their long-run equilibrium, reaching 380 basis points below control along their adjustment path, while in the more ambitious case they fall temporarily below their long-run equilibrium, reaching as much as 630 basis points below control. The fall in interest rates induces a real exchange rate depreciation (Figure 3i.) that is quite similar across the two scenarios in the short

30. The discounting here is done at a rate of 2.5 per cent per annum, just as in the previous section.

term, but in the medium term the exchange rate depreciates beyond its long-run equilibrium in the more ambitious case and converges smoothly to its long-run equilibrium in the moderate case.

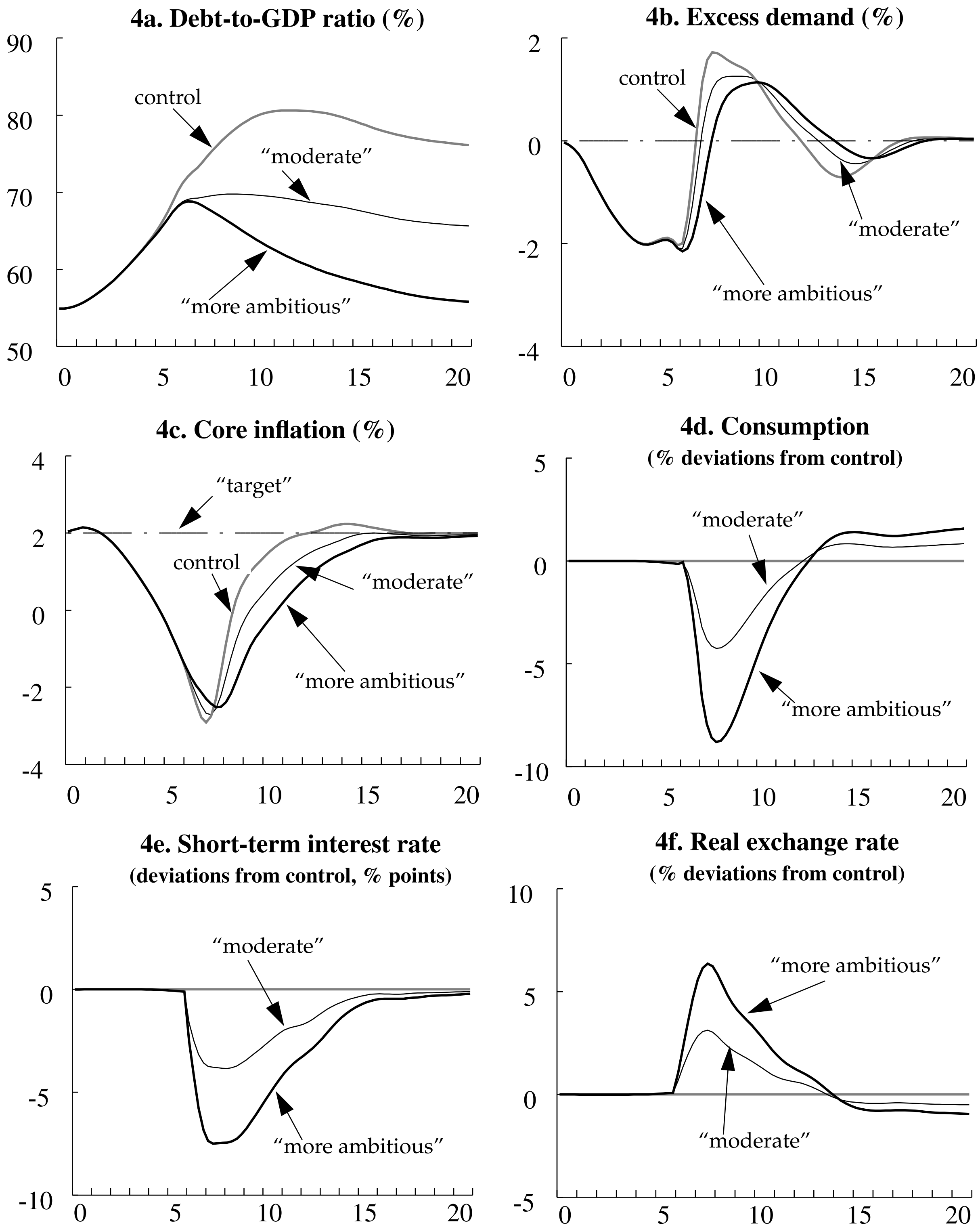
The short-run similarity in monetary conditions in the two scenarios produces very similar patterns for inflation (Figure 3j.) over the same horizon. In the very short run, inflation actually rises slightly relative to the control case, as the impact of the slightly weaker *nominal* exchange rate impinges on prices before the tax increases reduce aggregate demand and inflation. Looking beyond the very short run, inflation falls off quite quickly relative to the control. The cycle in monetary conditions in the more ambitious case reflects the fact that inflation in this scenario undershoots its long-run target in the medium term. Attempts to avoid having inflation fall below the target level by buffering further the declines in aggregate demand would, however, produce a sharper recovery that would result in more cycling in inflation and demand.

To summarize, the comparisons of the two scenarios show that the principal differences are, on the one hand, in the magnitude of the long-run benefits, which favor a more ambitious tactic, all else held equal, and on the other hand, in the cycle in output, consumption, inflation, interest rates, taxes and the deficit. The cycle in the more ambitious scenario manifests itself in a sharper drop in output and consumption relative to the steady state, which tends to favor the more moderate tactic. But, if the discounted present value of consumption is one's measure of welfare, it is the more ambitious scenario that wins out.

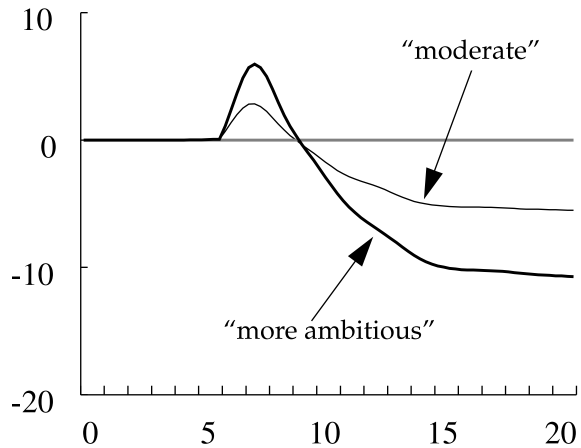
4. 2 Deficit and debt reduction in a state of excess supply

For our next set of experiments, we use a control solution that is similar in terms of the initial fiscal situation and the changes in fiscal policy that are introduced, but where the economic circumstances are otherwise quite different. We again begin with a situation of rapidly climbing government indebtedness, but we now create a scenario where there is excess supply in the product market and

Figure 4
Dynamic effects of debt reduction starting with excess supply
(time in years)



4g.: Nominal exchange rate
(% deviations from control)



downward pressure on inflation when the fiscal authority intervenes to tighten policy. To do this we have public debt rising initially owing to an autonomous drop in consumption and a small decline in taxes net of transfers. Long- and short-term interest rates are also arbitrarily increased from what they otherwise would have been in order to eliminate the normal monetary policy response to the consumption shock. Hence, in the new control solution, there is excess supply in goods markets instead of excess demand, and inflation is below its targeted rate and falling. We again assume that the initial target for the debt-to-GDP ratio is 55 per cent, but as the debt accumulation builds, the fiscal authority decides to shift the target up to 75 per cent of GDP rather than make the necessary adjustments to return to 55 per cent.[31] Thus, the fiscal situation in this control solution is broadly similar to that contained in the control used for the experiments described in the previous subsection.

31. At a technical level, the interventions are introduced in two parts so that the private sector does not anticipate the permanent shift in fiscal policy before it happens. In the first part, the constraint on taxes that was used to allow debt to rise sharply in the control scenario is gradually eased off, still using the original target ratio of government debt to GDP. This results in very gradual increases in the direct tax rate. Then, two and a half years later, it is assumed that the government, still faced with rising indebtedness, decides to reconsider the target ratio of government debt to GDP. This second part of the scenario is much more important than the first.

Against this backdrop, we again consider two alternative fiscal interventions: the establishment of a new target debt-to-GDP ratio of 65 per cent, which we again refer to as the “moderate scenario” (the new target is above the initial 55 per cent but well below the 75 per cent target that is implicit in the control path), and a “more ambitious” scenario of returning to a debt-to-GDP ratio of 55 per cent. Some of the dynamic implications of stemming or reversing the debt accumulation starting from a position of excess supply are shown in Figures 4a. to 4g.

The figures reveal that despite the different circumstances, the general impact of tighter fiscal policy is quite similar to that in the previous subsection, although there are some differences. The fiscal contraction again reduces aggregate demand, but in contrast to the previous scenario, this moves inflation away from its target. Lower inflation induces a sharp easing in monetary conditions that damps the short-run decline in aggregate demand, but as in the previous scenario, this easing is not sufficient to offset fully the impact of the fiscal intervention. To ease faster would result in more cycling in aggregate demand and inflation in the medium term.

In the previous scenario (with initial excess demand), the more ambitious case resulted in considerably larger output losses in the short run than did the moderate case; but in the current experiment the output path is quite similar for the two fiscal interventions. Looking at consumption, however, we again see that the short-run costs of debt reduction are considerably larger for the more ambitious case. While there is a larger easing of monetary conditions in the more ambitious scenario, this acts on aggregate demand largely by stimulating exports, rather than by limiting the decline in consumption.

Looking beyond the short run, we again see that the “more ambitious” intervention results in a larger permanent increase in consumption, and in present-value terms this continues to outweigh its larger short-run cost in terms of foregone consumption. The more ambitious intervention results in a net present-value gain in consumption that is equivalent to 35.5 per cent of one year's consumption, while the moderate scenario produces a net gain of 20.4 per cent.

5 Concluding remarks

In this paper, we present the simple arithmetic of debt and deficits, and we investigate the implications of rising government indebtedness using the Bank of Canada's new simulation model of the Canadian economy, QPM.

Our results suggest that the main economic cost of higher government debt is a lower sustainable level of consumption. The simple arithmetic shows that higher debt levels imply higher debt service costs and that to pay these additional debt service costs there must eventually be either higher taxes or lower government expenditures on goods and services or transfers to the private sector. Our simulation analysis based on QPM suggests, however, that this arithmetic is only part of the story. In our model simulations, there is a close link between government debt and international indebtedness. To the extent that increases in government debt stimulate aggregate demand in the short run, the resulting shortage of domestic savings is made up by increased foreign borrowing. This borrowing results in a rise in net international indebtedness, which implies larger sustained debt service payments to foreigners. Thus, while a rise in government debt is predicted to have only modest permanent effects on domestic output and employment, larger foreign debts substantially reduce the share of output that is available for domestic consumption.

Our steady-state simulations predict that the observed accumulation of net debt between 1980 and 1993 will result in a sustainable level of consumption that is 4 per cent lower every year than if the net debt had remained at its 1980 level. The steady-state simulations also suggest that the consumption costs of further increases in the debt-to-GDP ratio will likely be larger. The obvious implication is that there are substantial long-run benefits to halting the rise in the debt-to GDP ratio.

The dynamic simulations indicate that these long-run benefits can only be achieved at some considerable short-run cost. Since the short- and long-run effects of government debt move in opposite directions, any changes in debt or deficits imply important intergenerational transfers that rule out the possibility of making everyone better off. From a public policy perspective, any fiscal policy therefore requires making intergenerational welfare comparisons, and that is difficult. Our approach is to use a standard present-value criterion. Based on this criterion, we find that the long-run benefits of either stemming or reversing the recent rise in debt substantially outweigh the short-run costs associated with these policies.

For monetary policy, the message from our simulations is that a tighter fiscal policy will require monetary conditions to ease relative to what they otherwise would have been to maintain inflation near its targeted level. This monetary easing will reduce the impact of the fiscal tightening on real activity, but in our simulations it is not generally sufficient to offset the short-run costs of debt reduction. The basic reason is that to reduce debt from what it would otherwise be, national saving must rise, and this means that some consumption will have to be foregone in the short run.

Some of our results may depend, at least in their quantitative detail, on the choices we have made for the model's parameters. We would argue, however, that our calibration of the steady-state model, in particular, is likely to understate the implications of rising indebtedness. For example, we think that we have been modest in our calibration of possible real economic consequences of distortions arising from higher levels of taxation. Moreover, our elasticities of risk premiums with respect to government indebtedness are most likely too low at very high debt levels. Risk premiums at high debt levels can change rapidly with shifts in market perceptions about the sustainability of fiscal policy. There is very little hard quantitative evidence available as to the extent of this phenomenon, but the evidence we have does suggest that there may indeed be an important non-linearity. If this is so, then our results likely understate the benefits of stemming the rise in the level of public debt.

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