Using Financial Market Information to Enhance Canadian Fiscal Policy *

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Abstract

In this article we argue that the evaluation and implementation of Canadian fiscal policy could be significantly improved through the systematic use of information provided by global financial markets. In particular, we show how the information contained in internationally traded asset returns can be used to (1) provide a more meaningful cyclical–adjustment of the budget deficit, (2) assess the sustainability of the public debt, and (3) reduce the risk of the debt becoming unsustainable without having to run excessively large surpluses.

Key Words: Public debt, cyclically adjusted deficit, sustainability, hedging

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1 Introduction

In recent years Canada's federal government has experienced historically large and persistent budget surpluses. Not only were these surpluses large, they were also massively underestimated in the forecasts of both the private and public sector. According to some estimates, if the current trend continues the currently high level of public debt would be reduced to zero within 20 years. Such an outcome is unlikely however given the recent and anticipated reductions in income and corporate tax rates, and the substantial political pressure for re–investment in health and education. This situation is the exact opposite of that faced by the federal government in the 1980s. Then, Canada experienced historically large and persistent budget deficits, which were also massively underestimated. By the mid–1980s the debt–GDP ratio had become so large that many observers, in both the private and public sector, viewed it as unsustainable. A fiscal crisis was avoided via significant increases in taxation and cuts to health, education and other government services.

The picture painted by the preceding paragraph does not sound much like an optimal policy in the face of uncertainty like that described by Barro's (1979) tax–smoothing theory, for example. According to that view, taxation and expenditure policies would gradually adjust in response to rising or falling public debt to try to maintain intertemporal budget balance over time. In contrast, Canadian fiscal policy appears to be characterized by long periods of no significant change in policy in the face of changing economic conditions, interrupted by abrupt (and costly) shifts in "fiscal stance". There are several reasons for this departure from tax–smoothing. First, there are likely to be significant costs to adjusting taxes. Second, the fiscal response to rising debt may be delayed due to conflicts among different interest groups about how the burden of the required tax hikes and spending cuts is to be shared (see Alesina and Drazen, 1991). Finally, governments may have an incentive to time significant policy changes so as to minimize the political costs of (or maximize the political gains from) policy changes. For example, it may be no coincidence that the tax increases instituted by the Mulrooney government occurred soon after

their election, or that Chretien's recent tax cuts were promised just before the election.

In order to evaluate how much of the movement in the surplus is due to significant shifts in the stance of fiscal policy, it is necessary to separate out the movements that are due to exogenous factors such as business cycles. Traditionally this has been done by removing the components that are correlated with changes in GDP growth. However, there are a number of conceptual problems with this approach and it is not clear how well the adjustment captures the key exogenous shocks. In Section 2 we argue that it is conceptually appealing to use internationally traded asset returns to cyclically adjust the surplus. Moreover, we demonstrate that this approach does a much better job than the use of aggregate variables such as GDP growth or unemployment rates. Using this approach we show that a significant change in fiscal stance occurred in the mid–1980s and argue that this was likely a response to market pressures to do something about the public debt.

The approach to cyclical adjustment developed in Section 2 also makes possible a simple and flexible way to assess the "sustainability" of the public debt. We argue that the sustainability of the public debt cannot be simply judged by the debt–GDP ratio. For example, the Canadian debt–GDP ratio is currently higher than it was in the mid–1980s, but is somehow viewed as sustainable. Clearly, the degree to which the debt–GDP ratio is sustainable depends on an assessment of the present value of future surpluses. This in turn depends on current policies, current forecasts of economic growth and interest rates and the correlation of the surplus with the rate at which future cash flows are discounted. In section 3, we describe how to use our cash–flow model of the Canadian primary surplus and a calibrated asset pricing model to compute the present value of the primary surplus. Comparing this with the debt–GDP ratio, using the mid–1980s as a benchmark, we provide a flexible and easily applied measure of sustainability.

In the absence of state contingent borrowing and lending, a stable fiscal policy may become unsustainable as the effects of the exogenous shocks accumulate and result in a rising debt,[1] which could force the government to drastically raise taxes and cut spending in order to reduce

[1]Bohn (1991) provides several theoretical examples that illustrate the need for the government to issue state contingent bonds in stochastic economies.

the debt. The more volatile is the primary surplus, the more likely it is that the tax rate will have to be increased in the future. Given the problems of adjusting policy frequently and the costs of adjusting them infrequently, only after significant pressure for change has built up, the question arises as to whether there may be other ways of minimizing the adverse consequences of unexpected movements in the fiscal budget. In Section 4, we discuss the potential gains from systematic fiscal risk management. Hedging away the volatile component of the primary surplus that is associated with exogenous shocks might help to reduce the probability of an excessively large and rising public debt. We discuss the circumstances under which a simple hedging strategy can increase the sustainability of current fiscal policy and generate sizable welfare gains through diversification and lower expected future tax rates.

2 Cyclically Adjusting the Surplus using Asset Returns

In order to evaluate government policy, it is useful to decompose movements in the primary surplus into those resulting from exogenous shocks (e.g. business cycle fluctuations) and those induced by significant shifts in fiscal stance. Traditionally this "cyclical adjustment" has been done by identifying the component of the surplus that is correlated with shifts in GDP growth and, perhaps, unemployment. Once this component is removed the significant remaining movements in the surplus are interpreted as shifts in "fiscal stance". There are several problems with this standard textbook approach. First, it seems likely that shifts in domestic growth and unemployment may sometimes be induced by changes in government policy. Second, these crude aggregates do not fully reflect the true impacts of cyclical domestic activity on government accounts. Finally, given that Canada is a small open economy that has a large volume of trade, especially with the US, these domestic variables may not capture all of the exogenous factors influencing spending and revenue differences.

An alternative approach to the cyclical adjustment of the surplus is to use the market returns on a set of international financial assets to identify fiscal shocks. The idea behind this approach is

that if global financial markets are reasonably complete, then the relevant risk can be represented by some combination of these market returns.[2] The market return indices that we consider have been used extensively in the finance literature to represent underlying factors in stock market returns and to capture cyclical activity in the US. Since Canada is a small open economy, it is not unreasonable to assume that these international variables are not influenced by the government's fiscal policy.

The asset return variables that we use are the value weighted index of returns on the New York Stock Exchanges VWR, the dividend yield DIV on the value–weighted index (measured as a 1–year backward moving average of dividends divided by the most recent stock price), the 3–month Treasury bill rate TBILL, the 1 year moving average of the 3–month Treasury bill rate TBMA; and the yield on 10 year government bonds, LONGR. These variables, or linear combinations of them, have been found to forecast asset returns and are discussed in more detail in Campbell (1996). We multiply each of these by the nominal exchange rate to obtain the Canadian dollar value of the return on each US dollar invested.[3]

In Column 1 of Table 1 we run a simple linear regression of the surplus–GDP ratio on the asset returns over the period 1958:1–1994:4.[4] Although the Durbin–Watson statistic suggests that there is serial correlation in the residuals, this regression illustrates the striking fact that almost 70% of the variation in the surplus can be replicated by a simple linear combination of the asset returns. When we include a lagged dependent variable, as in the Column 2, the specification of the model improves (though it does not add much in terms of its explanatory power) and the parameters on the asset returns variables are quite robust to its inclusion.

We use these asset returns to cyclically adjust the surplus by removing the component of the surplus that is correlated with them. Figure 1 illustrates the adjusted and unadjusted primary surplus on an annual basis (although the adjustment was done using quarterly data). As can be

[2] This is referred to in the finance literature as the "spanning property".

[3] This ensures that the US dollar values of the returns are independent of the exchange rate and, therefore, Canadian government's policy.

[4] All of the variables that we consider, including the surplus–GDP ratio are stationary.

seen our approach to cyclical adjustment removes much of the cyclical variation. In particular, it adjusts for the high surpluses of the 1960s and the high deficits of the 1970s. After this adjustment the surplus largely fluctuates between 0 and 1% of GDP up until the mid-1980s. Note however that the significant upward shift in the 1980s to over 2% of GDP is not removed by cyclical adjustment. After this point, although the linear combination of asset returns continues to replicate the direction of movements in the surplus, it understates its true level. This movement is therefore consistent with a level shift in the permanent components of the government's fiscal policy. The CUSUM test (which is a t–statistic testing for structural stability) reported in the table shows that the null of no structural break is rejected at the 5% level.

Table 1 – Cyclical–Adjustment of the Primary Surplus

Variable	Column 1	Column 2	Column 3	Column 4	Column 5
VWR	0.005	0.012	0.003	0.00	0.003
	(0.57)	(1.56)	(0.43)	(0.43)	(0.04)
DIV	-1.28	-0.54	-0.69	-0.62	-0.70
	(12.97)	(5.01)	(7.09)	(6.40)	(5.05)
LONGR	-0.22	-0.08	-0.33	-0.32	-0.30
	(3.57)	(1.59)	(5.68)	(5.54)	(2.53)
TBILL	0.19	0.14	0.27	0.23	0.22
	(3.34)	(3.29)	(6.34)	(4.97)	(2.47)
TBMA	0.38	0.09	0.22	0.24	0.28
	(5.92)	(1.46)	(3.97)	(4.41)	(2.47)
DG	—	—	—	-0.07	—
				(1.85)	
UN	—	—	—	-0.37	—
				(2.38)	
Constant	0.0534	0.0218	0.0317	0.0287	0.0319
	(18.70)	(5.48)	(8.39)	(4.13)	(5.35)
SLAG	—	0.61	0.38	0.43	0.24
		(9.58)	(5.86)	(6.47)	(2.24)
SHIFT	—	—	0.0108	0.0097	—
			(6.70)	(5.93)	
NOBS	148	148	148	148	76
$\overline{R}^2$	0.68	0.81	0.85	0.86	0.75
D–W	0.69	2.06	2.04	2.14	1.96
CUSUM	5.69	3.63	—	—	—
FTEST	25.6	7.30	2.09	—	—
	[.000]	[.000]	[0.08]		

Notes:

(1) t–statistics are given in parenthesis.

(2) P–values in square brackets.

(3) In the first 2 columns, FTEST refers to a Chow test for a structural break in 1986:2. In the third it refers to a test of whether the coefficients on the X–variables across the regimes are the same.

(4) The X-variables are not demeaned in these regressions.

There are several reasons to suspect that there may have been a significant change in the fiscal stance of the Canadian government during the mid–1980s. These include the rapidly rising debt, the associated pressure from financial markets and a shift to a more conservative role for government. As Fortin (1999) notes "The fiscal authorities made a first attempt at fiscal consolidation in 1985–87, largely based on an increase in the overall tax rate from 32 to 35 percent of GDP." We identify the timing of this potential regime change by estimating a switching regression model. This estimation pinpoints a structural break as having occurred between the first and second quarter of 1986. We test the significance of a structural break at this date with a Chow test. As can be seen from Table 1 this hypothesis cannot be rejected at the 5% level.

To examine further the nature of this apparent regime switch we re–ran the regression by introducing a dummy variable which takes on the value one after 1986:2 and zero otherwise. The third column of Table 1 documents this regression. To test the stability of the parameters on the shocks and the lagged surplus across the two regimes, we also regressed the residuals from our preferred regression on the explanatory variables within each regime. We could not reject the joint hypothesis that these parameters are constant across regimes. In other words, the structural break is largely consistent with an increase in the permanent components of the surplus after the first quarter of 1986 rather than a change in the marginal responsiveness of the surplus to the shock variables. We interpret this as a significant shift in "fiscal stance".

Our baseline regression includes only financial asset returns. However, it may be the case that the inclusion of other cyclical variables will affect the results. In their multi–country panel data analysis, Roubini and Sachs (1989) find the effects of changes in the unemployment rate and the growth rate to be significant. Column 4 reports regression results for the effects of changes in real GNP growth, DG, and the unemployment rate, DU, in our sample. Although the unemployment variable is significant, it does not add much to the explanatory power of the model. Moreover the coefficients on the shock variables are robust to the inclusion of these alternative cyclical variables.

An important question for this cash–flow model to be useful both for cyclical adjustment and for forecasting the primary surplus is: are these parameters stable over time? Column 5 of Table 1 documents the results of estimating the model over the period 1958:1 to 1976:4. As can be seen the coefficient estimates are quite robust to this truncation of the sample period. The fact that we are able to identify the replicating portfolio *ex ante* suggests that our empirical specification should provide a useful basis for a conditional forecast of the surplus. Indeed, as Figure 2 illustrates, a forecast conditional on the realized asset returns and the shift in policy stance performs rather well in replicating the actual surplus in the post–sample period 1977:1 to 1994:4. This conditional forecast replicates over 80% of the variation in the surplus.

Based on these empirical results, we interpret the Canadian government's surplus process as follows: Under the fiscal policy regime that was in place in the 1960s and 1970s, exogenous fiscal shocks accounted for about 70% of the variation in the primary surplus. Until the mid–1970s, the combination of the policy regime and the shocks had resulted in positive surpluses on average. Beginning in the mid–1970s, however, the exogenous shocks caused a sustained period of deficits and resulted in the rising debt under the original policy rule. Instead of adjusting its fiscal policy immediately in response to the deficits and rising debt, the government's fiscal stance did not change significantly until 1986 when it adjusted the surplus level upward permanently. This adjustment, along with more favorable exogenous shocks, resulted in a return to positive primary surpluses in the late 1980s and early 1990s.

3 Assessing the Sustainability of the Public Debt

What level of the debt–GDP ratio can the Canadian economy afford ? This question has been asked many times in the recent past, but has not received a satisfactory answer. Based on estimates of average growth and interest rates, for example, the EC came up with a 60% rule as part of the Maastricht treaty. However, as recent experience has demonstrated, the debt–GDP ratio that an economy can afford depends crucially on the rate at which the economy is expected

to grow, expected interest rates, the volatility of these variables and the fiscal policy that the government is expected to pursue. For example, if growth is expected to be higher than usual, interest rates low and fiscal policy tight, a relatively high current debt–GDP ratio is sustainable. An inflexible policy rule may be unrealistic at best and may even result in overly restrictive policies that destabilize the economy.

A more useful way to pose the question is: *conditional* on current forecasts of the interest rate, growth rate and the current fiscal stance, what debt–GDP ratio will "the market" view as sustainable ? We address this question by computing the market valuation of expected future surpluses under the current fiscal stance and comparing it to the current debt–GDP ratio. The net debt — the difference between the actual debt and the estimated market valuation of future surpluses — measures the government's capacity to repay its debt *if it retains the existing tax policy.*

To compute this market valuation, we need to specify a process for the stochastic discount rate applied by the market in valuing future cash–flows. Since movements in this discount rate will also reflect global shocks, an important determinant of the present value is its covariance with the primary surplus. We take "the market" to be a representative US investor and assume that the "state of the world" is captured by the asset return indices discussed above. We model the evolution of these state variables as a vector–autoregressive process, which we estimate using quarterly data from 1958:1 to 1994:4. Table 3 gives the estimates. We then use the strong correlation between the primary surplus and the asset returns to generate the stochastic process for the primary surplus.

Table 3: VAR Estimates

	VWR	DIV	TBILL	LONGR
VWR(-1)	-0.10	-0.01	0.01	0.01
	(1.18)	(3.99)	(1.25)	(0.70)
DIV(-1)	3.82	0.96	0.05	0.18
	(4.45)	(37.06)	(0.58)	(1.27)
TBILL(-1)	-0.25	0.004	0.90	0.05
	(0.47)	(0.03)	(17.43)	(0.54)
LONGR(-1)	-1.01	0.02	0.06	0.81
	(2.16)	(1.62)	(1.28)	(10.33)

The process followed by the discount rate is determined by a term structure model like that discussed by Campbell and Viceira (1998) and Campbell, Lo and MacKinlay (1997). We assume that innovations in the discount rate are linearly related to innovations in the asset return indices discussed in section 2 and calibrate the weights on these innovations so that the average risk–free interest rate, the risk premium and the term premium implied by the model match those in US data. We then compute the present value of the primary surplus, holding fiscal policy constant, using the observed strong correlation between the primary surplus and the asset return indices to compute the covariance between the stochastic discount rate and the primary surplus. This calculation can be made at any point in time and used to compute the net debt–output ratio at that date.

It is our view that the government reached an upper bound on the net debt in 1986, which is when our earlier estimates suggest a significant shift in fiscal stance took place. At this is the point the net debt–GDP ratio reached a level that was deemed unsustainable by investors, given the current state of the world and the existing tax policy. Once the policy adjustment took place, the net debt–GDP ratio then fell to a sustainable level. The estimated net debt–GDP ratio in 1986 was approximately 5%. That is, the market viewed the debt as unsustainable when it reached a level that exceeded the present value of future surplus, under the existing tax policy, by about 5% of GDP.

Figure 3 illustrates the evolution of our estimate of the present value of future surpluses as a percentage of GDP in comparison with the debt–GDP ratio. As can be seen, while the debt fell until the mid 70s and then rose until the mid–90s, the present value under the normal tax regime fell throughout the period until the late 80s. The net debt, the difference between these two, rose throughout reaching the critical level of 5% in 1986. At this point, the present value increased abruptly following the shift in fiscal stance. Thus, while the debt is still higher than it was in 1986, it is sustainable because the present value of future surpluses became much higher after the tax hike. Note that the crisis regime present value is higher than the "true" present value

because it is calculated under the assumption that the high tax rate will remain indefinitely.

This approach to assessing the sustainability of the debt is much more useful than fixed rules such as those of the Maastricht treaty or indeed strict budget–balance rules. The Maastricht Treaty level of 60% is based on an estimate of an economy's steady–state capacity to pay given some "normal" fiscal regime. In a long–run steady state, the present value of future surpluses would be a constant fraction of GDP, so that our definition would be equivalent to a Maastricht–type rule. However, in the short–run, if growth prospects are bad and interest rates are high, a much lower debt–GDP ratio should be considered sustainable. Alternatively, in goods times a higher level can be sustained. Thus, our approach is much more flexible and, hence, more realistic.[5]

4 Hedging Against Shocks to the Surplus

According to the optimal dynamic taxation theories of Barro (1979) and Lucas and Stokey (1983), tax rates should be maintained at relatively constant levels and should not be used to offset all of the exogenous shocks to the primary surplus. For political and institutional reasons, fiscal authorities may not be able to adjust fiscal policy instantaneously. In the absence of state contingent borrowing and lending, however, a stable fiscal policy may become unsustainable as the effects of the exogenous shocks accumulate and result in a rising debt,[6] which could force the government to drastically raise taxes and cut spending in order to reduce the debt. The more volatile is the primary surplus, the more likely it is that the tax rate will have to be increased in the future. Given that much of the variation in the surplus can be replicated by the return on a portfolio of international securities, could the government mitigate the impact of these fiscal shocks by hedging the risk? Moreover, under what conditions would such a policy be desirable? In a recent article (Lloyd-Ellis and Zhu, 2001), we investigate the potential role for systematic

[5] The Maastricht rules specify some margins such that the debt can violate the upper bound for short periods. Although this is similar in spirit to our use of a bound on the *net* debt–GDP ratio, it is rather ad hoc.

[6] Bohn (1991) provides several theoretical examples that illustrate the need for the government to issue state contingent bonds in stochastic economies.

fiscal risk management as part of the government's overall debt policy.[7]

If Canada can be represented as a small open economy, the rate at which the market discounts future cash flows is exogenous with respect to domestic agents' actions. Furthermore, if world financial markets can be viewed as reasonably complete, welfare can be measured as the discounted present value of future production. For any given fiscal policy, investment decisions should then be made so as to maximize the present market value of production wealth.[8] Suppose the government taxes output (net of depreciation). For a given effective tax rate, the debt may increase rapidly if the surplus process experiences a large negative shock. *Ex ante*, the government can avoid some of these negative shocks through hedging.

We considered a simple hedging strategy that effectively replaces a volatile component of the primary surplus with a deterministic cash–flow that is a constant percentage of nominal GDP, and which has the same present value. We restrict our analysis to hedging strategies that are potentially feasible to implement in practice. To do so, we require that the hedging to be done with nominal securities rather than real or inflation indexed securities. To avoid potential moral hazard problems, we further require that the US dollar value of the cash–flow from the hedging portfolio to be a fixed function of the market returns and unaffected by the domestic government's fiscal policy changes. One way to implement such a hedging strategy is by entering into an Index–Linked–Swap with investors.[9]

By diversifying the market risk, the debt process under hedging becomes less volatile. However, whether the net debt is less likely to become unsustainable under hedging depends on the financial risk premium that must be paid to investors to absorb the risk. When the stochastic discount rate covaries positively with the hedged component of the primary surplus, which it does, the government must pay a risk–premium for downloading the risk to investors. In this

[7] Although the federal authorities do hedge against interest rate risk on a project–by–project basis, they do not systematically hedge against risk to their aggregate primary cash flows.

[8] With complete markets, the government's fiscal policy affects aggregate welfare only through its impact on the present value of production, *not* from smoothing consumption.

[9] Various kinds of Index–Linked–Swaps have now been widely traded by many financial institutions, although not with infinite maturity. We discuss the potential problems of implementing such a swap in the conclusion.

case, the cash–flow the government receives is actually negative. Although hedging makes the debt process less volatile, the debt will grow faster on average under hedging if the size of this negative cash–flow is too large.[10]

In order to quantify the hedging cost (and to evaluate domestic households' welfare), we specify a joint stochastic process for the shock variables, the discount factor, the effective real interest rate on domestic government debt, and domestic productivity growth. In addition to the assumptions already made in Section 3, we also assume that both domestic productivity growth and the effective real interest rate are linear functions of the state variables. Assuming a capital share of 36% and a quarterly depreciation rate of 2%, we calibrate the productivity growth process so that the implied stochastic process followed by the output growth generated by the model matches that in the Canadian data.

4.1 Implications for Sustainability

One way to evaluate the implications of hedging is to compare the evolution of the debt with and without hedging, given the realized path for the primary surplus, the effective interest rate and the asset returns. Suppose we take the perspective of a government that starts to hedge in 1977:1 and has only the information available up to the last quarter of 1976. As Figure 4 illustrates the debt-GDP ratio would not have risen as rapidly under hedging and would have been about half of its 1994 level.

However, while it is suggestive, this ex post evaluation of hedging is unfair because under different realizations (e.g. where the debt–GDP ratio falls) the debt could be higher under hedging. A more meaningful comparison is to look at the projected distribution of the debt with and without hedging, and in particular the likelihood that the net debt–GDP ratio reaches its upper bound within a given time period. Using the data from our simulation, we estimate the probability that the initial policy first becomes unsustainable. To do this we counted the fraction of paths along which the debt–GDP ratio hits the upper bound for the first time. Figure 5 shows

[10] This is analagous to the standard trade off between risk and return.

the evolution of this probability after 1977:1 both with and without hedging. Without hedging, the probability that the original policy rule would have become unsustainable within the following 200 quarters (i.e. by the last quarter of 2026), is 0.26. With hedging it drops to 0.05. In other words, hedging yields a five–fold increase in the sustainability of a given fiscal policy.

4.2 Tax Rates

Given a joint distribution over future fiscal policy and the stochastic discount rate, we can then compute the present value of aggregate expected GDP. With complete markets, changes in this present value provide a compensating variation measure of welfare that is independent of domestic preferences. To generate such a joint distribution, it is necessary to specify a particular policy rule that will determine tax rate as a function of the underlying state variables.

Consider the following policy rule that is consistent with the empirical behavior of the primary surplus we reported in section 2. Based on our earlier estimates, suppose that the government faces an upper bound on the net debt–output ratio of 5%. The effective tax rate remains at a "normal" level as long as the net debt-output ratio is below this upper bound. Whenever the ratio reaches or exceeds the upper bound, the tax rate is raised to a "crisis" level until the net debt, evaluated under the normal tax regime, falls to zero. At this point the effective tax rate is set back to its normal level. The normal and crisis tax rates can be inferred from the regression analysis in section 2, which implies values of 17.4% to 19.3% respectively.[11]

Figure 6 shows the average tax rates that result from the policy rule in our benchmark economy, with and without hedging over 500 quarters. As can be seen, the expected tax rates rise initially in both cases. The average tax rate rises less rapidly with hedging than without, reflecting the reduced likelihood of hitting the upper bound on the net debt level. Once the tax has been increased, the net debt begins to decline on average so that eventually, the tax rate can be reduced to its "normal level". Over time there are more paths realizing falling taxes on

[11] Note that these are federal rates.

average than there are paths realizing rising taxes, so that the average tax rate falls.[12] In the long run, the tax rate remains lower under hedging because (1) the probability of having to increase taxes in the future is lower, and (2) once the tax is raised, the average rate at which the net debt is reduced is greater.

– Figure 6 –

4.3 GDP Gains

We compute the percentage gain in the present value of GDP arising from hedging under a range of assumptions on parameters and initial conditions. We find that although the expected financial cost of hedging is 0.14% of GDP, the percentage increase in production wealth is between 0.36 and 0.63% (after factoring in the hedging cost). At first glance these gains, on the order of one half of one percent, may appear small. However, it should be realized that this is a half percent gain in GDP every quarter into the indefinite future. In comparison with other tax reforms this quite a substantial gain. For example, estimates of the gains from a reduction in capital taxes are estimated to be at most 1%, but Lucas describes them as the biggest free lunch ever.

Approximately 50% of these cumulative gains in GDP arise because, under our benchmark policy rule, hedging makes the high tax regime less likely to occur. The remaining 50% of the gains are due to *diversification*: the fact that high tax rates are more likely to occur in states where the deadweight losses due to taxes is low. While, in the absence of political and other constraints on government policy, this benchmark rule is clearly sub–optimal, it is consistent with our empirical observations *and* implies that the government's present value budget constraint is satisfied. Alternative policy rules that we considered reduced the gains from hedging because they reduce the likelihood of low taxes by more than they reduce the likelihood of high taxes.

[12] Note that even after the net debt is reduced to zero, some paths realize sufficiently bad shocks to make the net debt positive again and to eventually experience rising taxes again. However, the average tax rate still declines.

However, when the present value budget constraint is imposed, the reduction in the gain in production wealth is small, because of the gains diversification.

In our benchmark computations, the initial debt–GDP ratio was assumed to be its 1977 value of 20%. Raising the initial debt lowers welfare because the increase makes the need for a tax hike more imminent. However, as Figure 7 illustrates the effect of the initial debt on the percentage welfare gain from hedging is non–monotonic. When the initial debt is far below the upper bound, the probability of the net debt hitting the upper bound is very small and, therefore, the welfare gain from hedging is small. As the initial debt increases, the probability of the net debt hitting the upper bound increases and the welfare gain from hedging increases as well. If the initial net debt is too close to the upper bound, however, hedging actually *increases* the probability of a tax hike. With a high initial level and a strictly positive effective interest rate the net debt is expected to rise and hit the upper bound quickly, and hedging reduces the chance of having positive shocks to the surplus that would help to revert the upward trend. This reduction in sustainability reduces the gain in production wealth. This analysis illustrates that initial conditions matter: fiscal risk management should be viewed as a way of avoiding future debt problems not as a way of escaping from them.

4.4 Implementation Issues

Our analysis abstracts from several interesting and potentially important issues regarding the implementation of a fiscal risk management strategy. The hedging strategy that we considered requires the government to enter into an index–linked swap with an infinite maturity. It would be interesting to see if the strategy can be replicated with more conventional financial instruments. There is also the issue of default risk that is often associated with swaps of long maturity. In this paper we have dealt with this problem to some extent by having the payoffs of the swap denominated in US dollars. This eliminates the possibility of partial default by the Canadian government through inflation. Of course, this does not exclude the possibility of direct or indirect

default by the government through other means, and it would be interesting to evaluate the welfare gains from hedging by taking into account credit risk explicitly.[13]

Perhaps the biggest problem with implementing a systematic hedging strategy is the issue of time–consistency. We have assumed that once the government decides to implement the hedging strategy, it will stick to it in the future. However, as our simulations show, the gains from hedging depend crucially on the initial level of the net debt. A hedging strategy that is welfare improving *ex ante* may become welfare reducing *ex post* if a series of adverse and unhedgable shocks occur that cause the net debt to increase significantly in the future. In this sense fiscal risk management may become politically unpalatable.

One solution to these problems that we are currently working on, is to vary the maturity structure in of the debt in a way which, at least partially, replicates the hedge.[14] Since the asset returns that are important in our analysis are all related to different parts of the yield curve, it should be possible to systematically vary the maturity of new debt issues in a way that offsets cyclical variations to the primary surplus. The degree to which this can be done is limited by the quantity of new debt issued each period relative to the maturity structure of the existing stock. However, the transactions costs involved in implementing such a strategy may be lower than for direct hedging.

5 Concluding Remarks

Government cash flows are subject to unavoidable fiscal shocks that are outside the control of the fiscal authorities. In this paper we have demonstrated that many of the shocks to the Canadian federal surplus can be replicated using the return on a linear combination of internationally traded asset returns. We argue that using these asset returns to cyclically adjust the federal surplus is

[13] Note, however, that hedging should reduce the default risk premium already implicit in the effective interest rate on the debt, thereby offsetting the increased cost of hedging.

[14] Boothe and Reid (1992) and Missale and Blanchard (1994) also discuss the scope for reducing the costs of debt servicing by varying the maturity structure appropriately.

both conceptually appealing and quantitatively superior to traditional methods of adjustment. We also show that it is possible to characterize the surplus process over the last four decades as a stationary function of these shocks with an abrupt regime shift in 1986. Our results are consistent with the hypothesis that the recent rise in public debt experienced by Canada was the result of a series of negative shocks in the 1970s and 1980s, and a long delay in the adjustment of fiscal policy in response to the shocks.

The strong and stable correlation between the primary surplus and these asset return indices also provides a basis for a flexible and simple method for determining the implicit market assessment of the sustainability of the public debt under a given policy stance. Using 1986 as a benchmark we estimate the upper bound on the difference between the debt and the present value of future surplus to be about 5% of GDP. This rule is more flexible and realistically achievable than fixed debt–GDP ratios because it is conditional on market forecasts of future growth and interest rates and the current stance of government fiscal policy.

Although some fiscal shocks could be offset by varying tax rates and other policy parameters, this would create further distortions in the economy. The alternative of intertemporal smoothing through debt financing is ultimately unsustainable. Because of this conflict between stability and sustainability, systematic fiscal risk management might be beneficial as part of the government's overall debt management strategy. We discussed the feasibility of this, and argued that there are substantial potential gains from fiscal risk management in terms of increased sustainability, reduced tax rates and higher expected per capita GDP.

Data

Fiscal Variables

The quarterly primary surplus was calculated as the difference between total federal revenues and expenditures less interest payments on the debt, as published by Statistics Canada. For institutional reasons, this data exhibits considerable seasonal variation. Specifically, annual crown corporation cash flows are attributed only to the second quarter yielding a large "spike". We therefore used seasonally adjusted data. The surplus data does not include charges and subsidies relating to the Petroleum Compensation fund. Quarterly public debt figures are taken from IMF International Financial Statistics. The effective interest rate was calculated as the ratio of actual interest payments on the debt to value of the debt.

Asset Returns

VWR is the index of value–weighted returns on the NYSE taken from the CRSP tape. DIV is the dividend yield on the NYSE from the CRSP tape. LONGR is the nominal interest rate on 10 year US. government bonds. TBILL is the nominal 3–month US. treasury bill rate. TBMA is a one–year fixed–weight moving average of TBILL. All of these returns were converted into Canadian dollars using the spot U.S.–Canadian exchange rate taken from CITIBASE. Note that these returns should therefore be interpreted as the return in Canadian dollars on each U.S. dollar invested.

Other data

Unemployment data is take from OECD, *Main Economic Indicators*, various issues.

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