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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. As Figure 1 shows the overall federal surplus has been positive since the beginning of 1997. Not only were these surpluses large, they were also massively underestimated (at least initially) 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–GNP ratio had become so large that many observers, in both the private and public sector, viewed it as unsustainable.

What caused such big swings in budget balance? The worsening of the fiscal position in Canada is usually associated with Trudeau's second term and the Mulroney government. The return to fiscal surpluses is typically attributed to the Chretien government and, in particular, his finance minister Paul Martin. However, beyond the timing of these episodes, it is not clear whether it is valid to attribute the blame for deficits and credit for surpluses to these respective governments. The oil–shocks and global growth slowdown of the mid–1970s and the recessions of the early eighties were surely factors in the persistent deficits, while the return to higher growth during the late 1990s may have influenced the surpluses during that period. Moreover, when we remove interest payments on the debt and focus only on the primary surplus (see Figure 1), it may be seen that the return to positive primary surpluses actually first occurred in 1987. The subsequent improvement in the overall surplus had much to do with the declining interest payments on the debt.

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 or unanticipated growth slowdowns. Traditionally this has been done by removing the components that are correlated with deviations in output and unemploy-

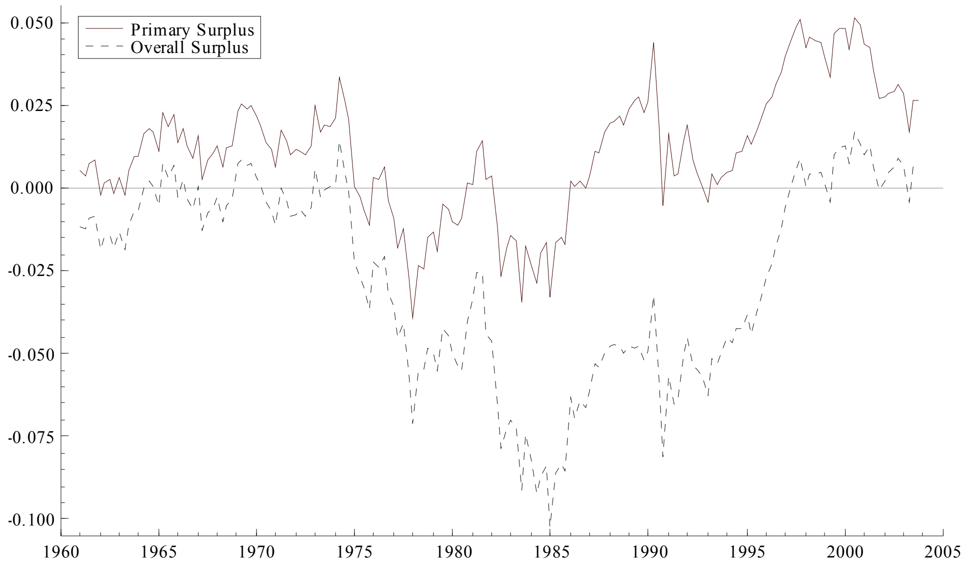

Figure 1: Evolution of the Federal Surplus

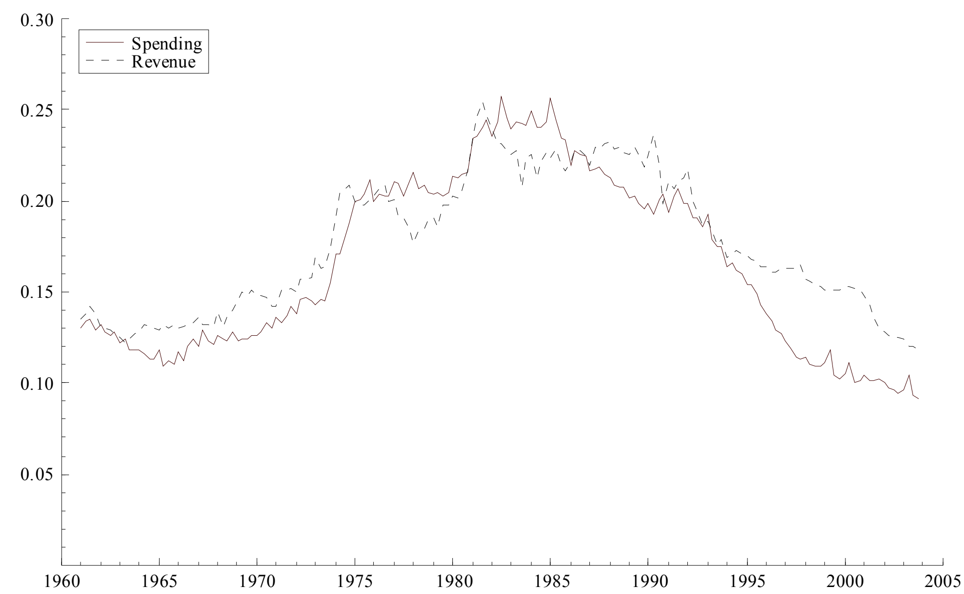

Figure 2: Revenue and Spending (non-interest)

ment from their "natural" levels. However, there are two problems with this approach. First, the traditional cyclical indicators do not capture much of the exogenous variations in surplus. Second, since it is likely that variations in these cyclical indicators are influenced by changes in fiscal policy, it is not clear that the cyclical adjustment is really controlling for exogenous shocks. In Section 2 we argue that it is conceptually more appealing to use internationally traded asset returns as instruments to identify the exogenous shocks to the surplus. We demonstrate that this approach does a much better job than the use of aggregate variables such as GNP growth or unemployment rates in capturing the fluctuations of the surplus. Using this approach to controlling for exogenous shocks, we find that a significant shift in fiscal stance seems to have occurred in the late 1980s and argue that this was likely a response to market pressures to do something about the public debt. We estimate that there was a tightening of fiscal policy between 1987 and 1991, when the primary surplus averaged more than one percentage point higher than would normally have been the case given the state of the world.

The approach to shock 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–GNP ratio. For example, the Canadian debt–GNP ratio is currently higher than it was in the mid–1980s, but is somehow viewed as sustainable. Clearly, the degree to which the debt–GNP 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–GNP 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 exogenous shocks accumulate and result in a rising debt, 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 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 gains in the nation's wealth (as measured by the present value of its current and future GNP) through diversification and lower average tax rates.

2 The Shock–Adjusted Federal Surplus

In order to evaluate the government's fiscal policy, one would like to decompose movements in the primary surplus into those resulting from exogenous shocks (e.g. business cycle fluctuations, unanticipated growth slowdowns) and those induced by significant shifts in "fiscal stance". In this section we discuss a decomposition method that we first introduced in Lloyd-Ellis and Zhu (2001). Let $\mathbf{z}_t$ be the state vector that summarizes the exogenous shocks in period t.

We assume that the government's primary surplus in period t can be decomposed into two parts:

$$S_t = \Gamma_t \bar{y}_t + F_t(\mathbf{z}_t). \tag{1}$$

where $\bar{y}_t$ represents trend GNP, Γ_t denotes permanent (i.e. non–shock related) components of the fiscal surplus and $F_t(\mathbf{z}_t)$ components of the fiscal surplus that are shock–related. We interpret significant and persistent changes in Γ_t as being associated with changes in the fiscal stance of the government.

Let $s_t = S_t/\bar{y}_t$, and $f_t(\mathbf{z}_t) = F_t(\mathbf{z}_t)/\bar{y}_t$. The ratio of the primary surplus to trend output can then be expressed as

$$s_t = \Gamma_t + f_t(\mathbf{z}_t). \tag{2}$$

In general, the state vector $\mathbf{z}_t$ may contain variables that are difficult to identify or not directly observable. Let $\mathbf{X}_t$ be a vector of observables that are correlated with the state vector $\mathbf{z}_t$. Using linear approximation we can express $f_t(\mathbf{z}_t)$ as follows:

$$f_t(\mathbf{z}_t) = \mathbf{a}'\mathbf{X}_t + \varepsilon_t,$$

where ε_t is the residual that represents the shocks that are not captured by the observables. Thus, the primary surplus can be expressed as

$$s_t = \Gamma_t + \mathbf{a}'\mathbf{X}_t + \varepsilon_t. \tag{3}$$

So, the first step in our decomposition method is to identify the vector of observables, $\mathbf{X}_t$. Once these variables are identified, we can then use regression to estimate the shock dependence vector $\mathbf{a}$. Finally, given the estimated $\mathbf{a}$, we adjust surplus for shocks by simply subtracting $\mathbf{a}'\mathbf{X}_t$ from the actual surplus s_t. So, the *shock-adjusted surplus* is defined as $\widehat{s}_t = s_t - \mathbf{a}'\mathbf{X}_t$.

The traditional *cyclically-adjusted surplus* is a special case of the shock-adjusted surplus that we defined above when the variables in $\mathbf{X}_t$ are identified as cyclical deviations of unemployment and output from their "natural" levels. Although, measurement of the natural levels of output and unemployment is always problematic, one common proxy is to use a backward moving average of the actual levels. Column 1 in Table 1 presents the results from a regression of the primary surplus relative to trend GNP on three “traditional variables”: YGAP, the percentage deviation between current real GNP and a 1–year backward moving average of real GNP; UGAP, the difference between the current rate of unemployment and a 1–year backward moving average; and MAU, the moving average of the unemployment rate. We have included the latter term to capture longer term movements in unemployment which may have impacts on government expenditures.[1] The regression uses quarterly data over the period 1961:1–2003:4.

As can be seen from the results, while all of these variables are significantly related to the surplus they do not account for much variation in it. Perhaps not surprisingly therefore, as Figure 2 illustrates, the predicted primary surplus does not capture what we might *a priori* believe to be important exogenous movements in the primary surplus. While it picks up that sharp swing into a deficit position following the 1981-2 recession (reflecting what turned out to be a persistent increase in unemployment), this seems to be the only evidence of a relationship. Although,

[1] Including the moving average of real GNP is conceptually problematic because it is obviously trending upwards.

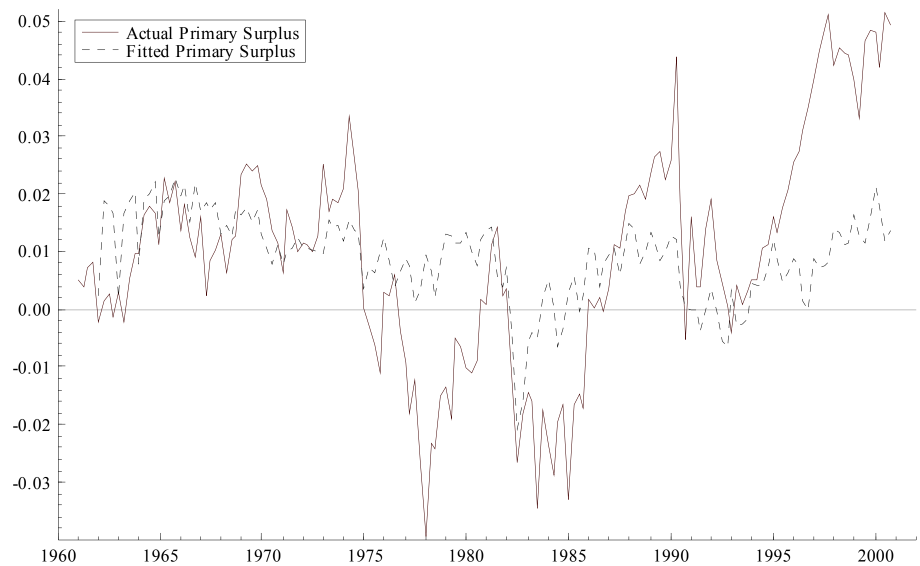

Figure 3: Traditional Cyclical Adjustment

our approach here is not particularly sophisticated, this picture is in fact representative of a wide variety of similar approaches to cyclical adjustment. (See, e.g., Chapter 27 of Blanchard, Jonhson, and Melino, 2003.)

The failure of the standard cyclically-adjusted surplus in capturing policy changes is not unexpected. For the decomposition method to work well, the observable vector $\mathbf{X}_t$ should satisfy at least two conditions: (1) it contains variables that can capture a significant portion of exogenous shocks that affect the surplus so that we can more confidently attribute changes in shock-adjusted surplus to policy changes, and (2) it only contains variables that are exogenous to fiscal policy changes so that any policy changes will be captured in the shock-adjusted surplus. The shock variables used in the traditional cyclically-adjusted surplus do not satisfy either of these conditions. As we pointed out, the cyclical indicators do not capture much of the variation in the surplus. Furthermore, it is likely that shifts in domestic growth and unemployment are sometimes induced by changes in fiscal policy, so that they cannot be thought as exogenous.

Here we consider an alternative approach to adjusting the surplus for exogenous shocks (cyclical and non–cyclical). We use indices of the market returns on a set of internationally traded financial assets to identify shocks to the surplus. If global asset markets were complete, then it would be possible to replicate the impact of all global economic shocks using some combination of market returns. This is sometimes referred to in the finance literature as the "spanning" property (see Duffie, 1986), and is analogous to the use of relative prices to infer sectoral productivity shocks under the assumption of competitive markets (e.g. investment–specific technical change). While, in reality, such markets are unlikely to be complete, we take this as a first approximation. 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 (VWR) on the New York stock exchange, the dividend yield (DIV) on the value weighted index (measured as a 1–year backward moving average of dividends divided by the stock price), the yield on 10 year government bonds (LONGR), the 3–month Treasury bill rate (TBILL), and a 1–year backward moving average of the Treasury bill rate (TBMA). These variables, or linear combinations of them, have been found to forecast US asset returns and are discussed in more detail in Campbell (1996). For our purposes, we view these variables as picking up key components of the shocks affecting the world economy. Some of these shocks may be expectational in nature, while others are productivity related.

In Column 2 of Table 1 we run the simple linear regression given in (3) on quarterly data over the period 1961:1–2003:4, where now $\mathbf{X}_t$ is the vector of de–meaned asset returns. Note that we use trend rather than actual GNP, so that all of the variation in s_t is coming from the numerator. Moreover, the primary surplus is measured in US$ by converting at the spot exchange rate.[2] This regression illustrates the striking fact that two thirds of the variation in the surplus can be replicated by a simple linear combination of these asset returns. Figure 3 shows the actual and fitted primary surplus implied by this relationship. In column 3 we also include the more traditional cyclical adjustment variables. As can be seen, although the unemployment variables remain marginally significant, these variables add little in terms of explanatory power.

[2] This is necessary for the valuation procedures discussed subsequently. Moreover, it implies that the regression will also pick up any shocks to the exchange rate captured by the financial variables. Note that the results do not change qualitatively when measured the surplus in Canadian dollars.

Figure 4 depicts the residuals, which may be viewed as an estimate of the shock–adjusted surplus. Although, this series exhibits considerable volatility, the adjusted surplus tends to exhibit much less persistence than the actual surplus. One exception to this general rule, which stands out, occurs in the late 1980s when the shock–adjusted primary surplus becomes persistently large and positive for several years. According to our interpretation, this period stands out as one when there was a significant tightening in the fiscal stance of the government. To explore this interpretation further, we ran the same regression but included a dummy variable which took on the value 1 during the period 1987:1 to 1991:4, and zero otherwise. As the results in Column 4 indicate, the coefficient on this dummy is statistically significant at the 1% level and suggests that the surplus averaged over one percentage point higher than predicted by the shocks.

There are several reasons to suspect that there may have been a significant change in the fiscal stance of the Canadian government during the late–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 GNP."

In interpreting this relationship and in using it for our purposes, we must first address two questions: is this relationship stable over time and is it simply the result of some spurious relationship due to trends in the variables? Column 5 of Table 1 documents the results of estimating the model over the first half of the sample period 1961:1 to 1982:2. As can be seen the coefficient estimates are fairly robust to this truncation of the sample period. The fact that we are able to identify these parameters *ex ante* suggests that our empirical specification should provide a useful basis for a conditional forecast of the surplus. Indeed, a forecast conditional *only* on the realized asset returns, performs reasonably well in replicating the actual surplus in the post–sample period 1982:3:1 to 2003:4. This conditional forecast replicates over 80% of the variation in the actual surplus.

Although there are no obvious long term trends in the data, standard unit–root test applied to the surplus and the asset return indices cannot reject the possibility of non–stationarity. Although, these tests are well known to lack power in finite samples, it is possible that the strong relationship

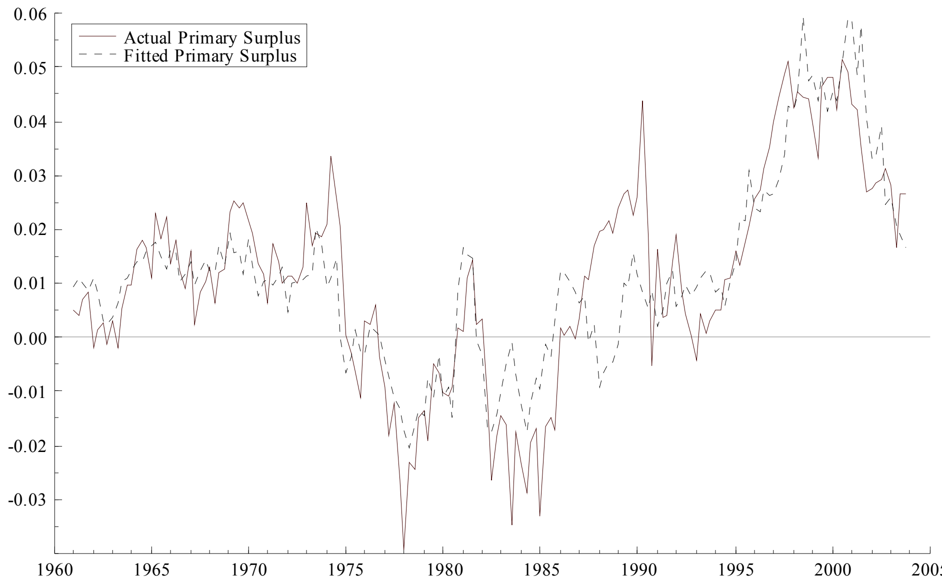

Figure 4: Shock–Adjustment with Asset Returns

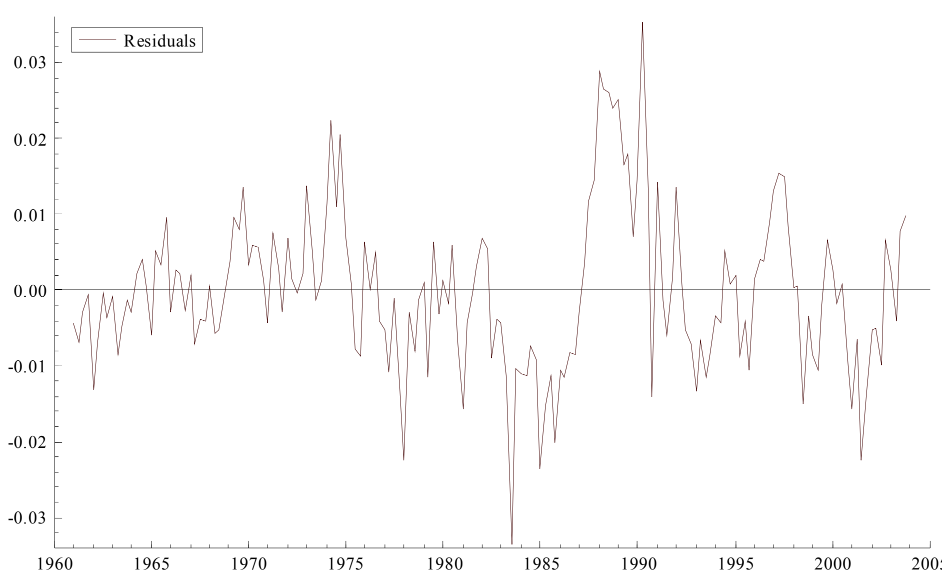

Figure 5: The Shock–Adjusted Surplus

identified above reflects spurious correlations due to trends and/or random walks in the data. However, using standard cointegration tests, we cannot reject the hypothesis that there does exist a meaningful stationary long run relationship between the primary surplus and all of the asset returns.[3] Column 6 reports the parameter estimates from the cointegrating vector implied by an error–correction model. As may be seen, the estimates are almost identical to those implied by the OLS regression, suggesting that these partial correlations are not spurious.

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 late in 1986 when it adjusted the surplus level upward for about 4 years. This adjustment, along with more favorable exogenous shocks, resulted in a return to positive primary surpluses in the late 1980s and early 1990s. Interestingly, our results suggest that this tight fiscal regime ended *prior* to the election of Chretien's liberal government.[4]

3 Assessing the Sustainability of the Public Debt

What level of the debt–GNP ratio can the Canadian economy afford? This question has been asked many times in the recent past, but we do not believe it has received a satisfactory answer. Bruce and Purvis (1985) suggested the concept of "fiscal prudence" as a guide for budget policy in pursuit of a debt-ratio target. Wilson and Dungan (1993) also discuss the conditions for the "sustainability" of fiscal programs, where sustainability means control of the debt ratio. Rudin and Smith (1994) proposed a simple indicator of sustainability in fiscal policy, defined in terms of the present–value budget balance. However, because this definition does not preclude continuous

[3] We used the Johansen (trace) test. See Davidson and MacKinnon (1993), chapter 20.

[4] Of course, federal spending and taxation declined substantially under Paul Martin, but the difference between them was largely accounted for by the shock variables.

growth in the debt ratio, a collateral constraint on the debt ratio is required. Curtis (1997) uses a set of indicators of fiscal policy sustainability, suggested by Blanchard (1993), that define fiscal targets and measure the fiscal adjustment required to maintain a constant debt ratio.

Clearly, the debt-GNP ratio that an economy can afford depends on future surpluses, which are functions of future GNP growth rates, interest rates, and other exogenous shocks, as well as the fiscal policy in the future. For a given fiscal policy, whether a certain level of debt-GNP ratio is viewed sustainable depends crucially on what the expected future surpluses are. For example, the EC came up with a 60% rule as part of the Stability Pact, which was thought to be sustainable based on some simple estimates of average growth and interest rates. However, as recent experience has demonstrated, due to fluctuations in growth and interest rates, a debt–GNP ratio that was originally thought to be sustainable may become unsustainable when expected growth and interest rates change.[5] As the state of an economy evolves, expectation of future surpluses may change too. Therefore, it is not meaningful to ask what level of the debt–GNP ratio can the economy afford independent of the state of the global and domestic economy.

A more useful way to pose the question is: *conditional* on current forecasts of future surpluses, what debt–GNP 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–GNP 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 maintains the existing fiscal stance.*. The decomposition method that we discussed in the last section allows us to determine what the process of future surpluses is. In order to determine the market valuation of the primary surplus, however, we choose a valuation method, which is based on several assumptions.

3.1 Assumptions for Valuation of Future Surpluses

We assume that there is a complete world financial market in which all contingent claims with payoffs (measured in US$) that are functions of z_t can be traded. Under this assumption and the assumption of no–arbitrage, there exists a unique sequence of stochastic discount factors, $\{M_t\}_{t\succeq 0}$,

[5] The recent experience of Germany illustrates this point nicely.

such that the time t price of a contingent claim that pays $q(z_t)$ units of the consumption good in period $t+j$ is

$$\Pi(t,j) = E_t\left[\frac{M_{t+j}}{M_t}q(z_{t+j})\right] \tag{4}$$

We assume that Canada is a small open economy, so that the stochastic discount factors are exogenous with respect to domestic agents' actions. In particular, changes in the domestic government's fiscal policy has no effect on them.

Given our specification for the primary surplus in (2), if the government's fiscal stance continues to be Γ in the future, the present value of the government's primary surpluses (measured in US$) can be expressed as

$$V_t(\Gamma) = \frac{1}{M_t}\sum_{j=1}^{\infty} E_t M_{t+j}[\Gamma + f_{t+j}(z_{t+j})]\bar{y}_{t+j} \tag{5}$$

To convert this to Canadian dollars we simply multiply by the current exchange rate.

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. Specifically, we assume that the vector $\tilde{\mathbf{X}}_t = (X_{1,t}, X_{2,t}, X_{3,t}, X_{4,t})$, which consists of the demeaned asset returns VWR, DIV, LONGR and TBILL, follows a vector autoregressive (VAR) process:

$$\tilde{\mathbf{X}}_t = \mathbf{A}\tilde{\mathbf{X}}_{t-1} + \mathbf{u}_t \tag{6}$$

where $\mathbf{A}$ is a matrix of coefficients, $\mathbf{u}_t$ is i.i.d., and $\mathbf{u}_t \sim N(\mathbf{0}, \mathbf{\Sigma})$. Note that the vector $\tilde{\mathbf{X}}_t$ does not include one of the factors we used in $\mathbf{X}_t$ —TBMA, the one–year moving average of TBILL. However, given the estimated process for the asset returns, the value of TBMA can be easily constructed. Table 2 provides the estimated process using quarterly data from 1961:1 to 2003:4.

3.2 Asset Pricing Model

Let r_t be the interest rate on the 3-month Treasury bills, r_t^L be the yield on 10-year Treasury bonds, R_t^m be the nominal return on the market portfolio. Then, the following no–arbitrage conditions should hold for any asset pricing model:

$$E_t\left[\frac{M_{t+1}}{M_t}\exp(r_t)\right] = 1, \tag{7}$$

$$E_t\left[\frac{\frac{1}{2}\left(\sum_{j=1}^{20} M_{t+2j}r_t^L\right) + M_{t+40}}{M_t}\right] = 1, \tag{8}$$

$$E_t\left[\frac{M_{t+1}}{M_t}R_{t+1}^m\right] = 1. \tag{9}$$

where $r_t = E[r_t] + \frac{1}{4}X_{4t}$, $r_t^L = E\left[r_t^L\right] + X_{3t}$ and $R_t^m = \exp(X_{1t})$.

In our calculations, we extend the term structure model discussed in Campbell and Viceira (1998) and Campbell, Lo and MacKinlay (1997) by allowing the innovation in the stochastic discount factor to be correlated with the innovations in the shock variables. Specifically we adopt the following specification for the growth in the discount factor:

$$-\ln\left(\frac{M_t}{M_{t-1}}\right) = r_{t-1} + \frac{1}{2}\sigma^2 + \omega_t, \quad \omega_t \sim N(0,\sigma^2), \tag{10}$$

where ω_t is i.i.d., $\omega_t \sim N(0,\sigma^2)$, and $E[\omega_t \mathbf{u}_t] = \mathbf{v}$. Under this specification, the first moment condition (7) is always satisfied by construction. We further assume that

$$\omega_t = \rho_1 u_{1,t} + \rho_4 u_{4,t}. \tag{11}$$

That is, the innovation in the stochastic discount factor is a linear combination of the innovation in the 3-month interest rate and the innovation in the return on market portfolio. Then, we have

$$\sigma^2 = \rho_1^2\sigma_{1,u}^2 + \rho_4^2\sigma_{4,u}^2 + 2\rho_1\rho_4\sigma_{14,u}, \tag{12}$$

$$\mathbf{v}' = (\rho_1, 0, 0, \rho_4)'\mathbf{\Sigma}. \tag{13}$$

We calibrate the parameters ρ_1 and ρ_4 so that the other two moment conditions, (8) and (9), hold on average over the sample period 1975:1–2003:4.[6] For more details on calibration, see Appendix 2.

[6] The asset pricing models we consider are homoskedastic, which implies that both the term premium and the equity premium are constant over time. In the data, however, these premiums are time–varying. Therefore, the calibrated parameters will be dependent on the sample period. Since we are concerned about values during the 1980s and 1990s, we chose 1975:1-2003:4 as the sample period for the calibration exercise.

Let $D_t(\Gamma)$ be the stock of government debt (in Cdn. \$) at the end of period t, when the fiscal stance is Γ. Then, we have

$$D_t(\Gamma) = (1 + r_{t-1})D_{t-1} - [\Gamma + f_t(\mathbf{z}_t)]\bar{y}_t. \tag{14}$$

where r_t is the effective real interest rate on government debt. We define the real "net debt" as the real debt minus the present value of future surpluses *under the existing tax policy*, $D_t(\Gamma) - V_t(\Gamma)$. The net debt measures the government's ability to repay its debt if it retains the existing tax policy.

Figure 6 illustrates the evolution of our estimate of the present value of future surpluses as a percentage of GNP in comparison with the debt–GNP ratio. As can be seen, while the debt–GNP ratio 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 1987.

It is our view that the government reached an upper bound on the net debt by the end of 1986, which is when our earlier estimates suggest a significant shift in fiscal stance took place. This is the point at which the net debt–GNP 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–GNP ratio then fell to a sustainable level. The estimated net debt–GNP ratio iby the end of 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 GNP.

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 GNP, 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–GNP 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.

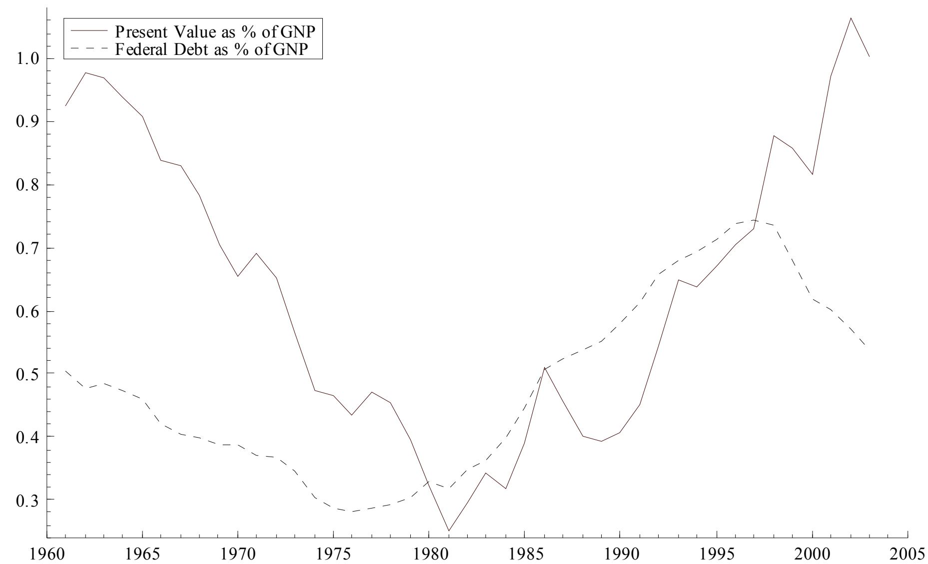

Figure 6: Debt and the Value of Future Surpluses under a given fiscal regime

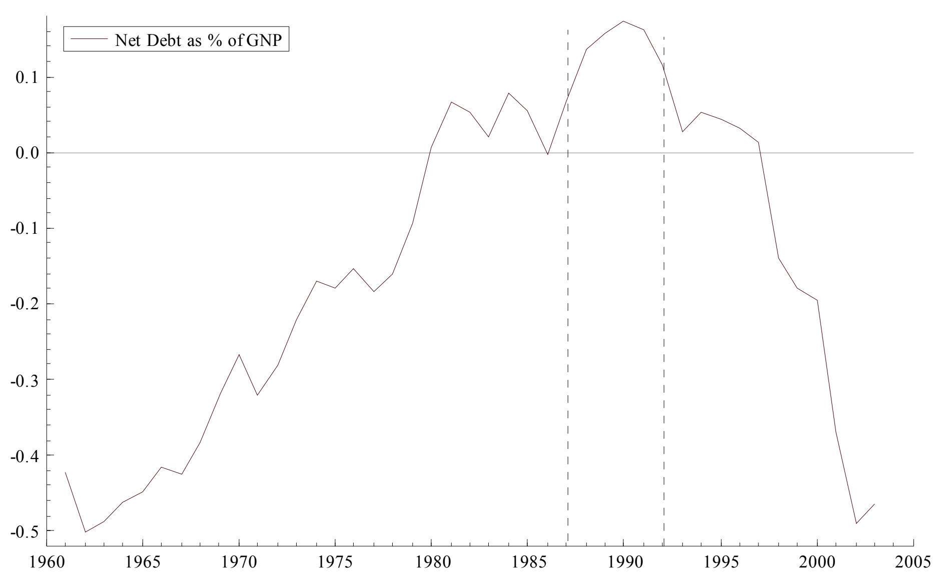

Figure 7: The Net Debt

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–GNP ratio, it is rather ad hoc.

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, 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 fiscal risk management as part of the Canadian government's overall debt policy.

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, aggregate welfare can be measured as the discounted present value of future GNP. For any given fiscal policy, investment decisions should then be made so as to maximize the present market value of production wealth. 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. 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 GNP, 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 the hedging to be done with nominal securities rather than real or inflation indexed securities. To avoid potential moral hazard problems, we further require 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. 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 below).

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 co–varies 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 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. This is analogous to the standard trade off between risk and return.

In order to quantify the hedging cost (and to compute the expected present value of GNP), we specified 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.

We computed the percentage gain in the present value of GNP 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 GNP, 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 GNP 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 in the US are estimated to be at most 1%, but Robert Lucas (1990) has described them as the biggest free lunch ever.

Approximately 50% of the cumulative gains in GNP 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 loss due to taxation 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. However, when the present value budget constraint is imposed, the reduction in the gain in production wealth is small, because of the gains that remain from diversification.

These results from our 2001 paper are based on the relationship between the surplus and the asset returns estimated up to 1994:4. In section 2 we estimated the same relationship up to 2003:4. Strikingly, the addition of 9 years of quarterly observations did not change these estimates, re–enforcing our earlier claim of parameter stability. It follows that the estimated welfare gains from hedging described above would remain unchanged. Of course, as with any welfare evaluation, our estimates are sensitive to the specification of our theoretical model. Moreover, we made a number of strong assumptions regarding the implementation of the strategy, which we address below.

4.1 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 our 2001 paper we 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. 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.

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. 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. 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.

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 argued that many of the shocks to the Canadian federal surplus can be replicated using a linear combination of internationally traded asset returns. We argue that using these asset returns to cyclically adjust the federal surplus is both conceptually appealing and quantitatively superior to traditional methods of adjustment. We also show that it is possible to approximte the surplus process over the last four decades as a stationary function of these shocks with an abrupt regime shift between 1987 and 1991. Our results are consistent with the hypothesis that the 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 1987 as a benchmark we infer that the maximum sustainable difference between the debt and the present value of future surplus to be about 5% of GNP. This rule is more flexible and realistically achievable than fixed debt–GNP ratios because it is conditional on market forecasts of future surpluses 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 GNP.

Table 1 – Adjusting the Primary Surplus for Shocks

Variable	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
VWR	—	-0.038*	-0.038*	-0.040*	-0.058*	-0.038
		(0.010)	(0.011)	(.009)	(0.011)	
DIV	—	-1.21*	-1.43*	-1.22*	-1.48*	-1.20
		(0.10)	(0.11)	(0.09)	(0.14)	
LONGR	—	-0.36*	-0.13	-0.42*	-0.42*	-0.36
		(0.07)	(0.09)	(0.06)	(0.09)	
TBILL	—	0.21*	0.12*	0.23*	0.20*	0.20
		(0.04)	(0.04)	(.04)	(0.04)	
TBMA	—	0.23*	0.23*	0.25*	0.38*	0.23
		(0.05)	(0.06)	(0.05)	(0.06)	
MAU	-0.24*	—	-0.19*	—	—	—
	(0.05)		(0.04)			
UGAP	-0.61*	—	-0.21*	—	—	—
	(0.16)		(0.11)			
YGAP	-0.07*	—	-0.04	—	—	—
	(0.035)		(0.02)			
DUM	—	—	—	0.012*	—	—
				(0.002)		
NOBS	172	172	172	172	86	172
R^2	0.19	0.67	0.72	0.74	0.75	
D–W	0.28	0.74	0.74	1.04	1.35	

Notes:

(1) Standard errors are given in parenthesis.

(2) * indicates statistical significance at the 5% level

Table 2: VAR Estimates

	VWR	DIV	TBILL	LONGR
VWR(-1)	0.18	-0.01	0.01	0.01
	(0.07)	(0.004)	(0.01)	(0.02)
DIV(-1)	2.23	0.85	-0.07	-0.11
	(0.68)	(0.04)	(0.09)	(0.18)
TBILL(-1)	-0.71	0.03	0.91	0.41
	(0.40)	(0.02)	(0.05)	(0.11)
LONGR(-1)	0.18	0.01	0.05	0.59
	(0.28)	(0.02)	(0.04)	(0.08)

Notes:

(1) standard errors are given in parenthesis.

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Appendix 1: The Data

Fiscal Variables

The quarterly primary surplus was calculated as the difference between total federal revenues and outlays less interest payments on the debt, as published by Statistics Canada (CANSIM II). 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. Debt figures are from Statistics Canada's CANSIM II database and refer to gross federal Canadian debt. This does not include off-balance sheet items, such as the Canada pension plan.

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. The exchange rate and GNP data are taken from CANSIM II.

Appendix 2: Calibrating the Two–factor Asset Pricing Model

From (7), (10) and (12), the moment condition (9) can be written as follows:

$$\exp\left(E_t\left[R^m_{t+1}\right] - r_t + \frac{1}{2}\sigma^2_{1,u} - \rho_1\sigma^2_{1,u} - \rho_4\sigma_{14,u}\right) = 1 \tag{15}$$

or

$$E_t\left[R^m_{t+1}\right] - r_t + \frac{1}{2}\sigma^2_{1,u} - \rho_1\sigma^2_{1,u} - \rho_4\sigma_{14,u} = 0. \tag{16}$$

Taking unconditional expectations of the left hand side of the equation yields

$$E\left[R^m_t - r_t\right] + \frac{1}{2}\sigma^2_{1,u} - \rho_1\sigma^2_{1,u} - \rho_4\sigma_{14,u} = 0. \tag{17}$$

Replacing the theoretical moments with sample moments, we have

$$\frac{1}{T}\sum_{t=1}^{T}\left(R^m_t - r_t\right) + \frac{1}{2}\sigma^2_{1,u} - \rho_1\sigma^2_{1,u} - \rho_4\sigma_{14,u} = 0. \tag{18}$$

Using (7) and (8) we have

$$E_t\left[\frac{M_{t+2j}}{M_t}\right] = \exp\left(-\left(E[r_t] + \frac{1}{2}\sigma^2\right)2j - m_z(t,2j) + \frac{1}{2}V_{zz}(t,2j)\right). \tag{19}$$

where

$$m_z(t,2j) = E_t\left[-(\ln M_{t+2j} - \ln M_t) - 2\mu j\right]$$

and

$$V_{zz}(t,2j) = E_t\left[\left(-(\ln M_{t+2j} - \ln M_t) - 2\mu j - m_z(t,2j)\right)^2\right].$$

So, the moment condition (8) can be written as

$$\begin{aligned} 1 \quad = \quad & \frac{1}{2}\left[\sum_{j=1}^{20}\exp\left(-\left(E[r_t] + \frac{1}{2}\sigma^2\right)2j - m_z(t,2j) + \frac{1}{2}V_{zz}(t,2j)\right)\right] r^L_t \\ & + \exp\left(-\left(E[r_t] + \frac{1}{2}\sigma^2\right)40 - m_z(t,40) + \frac{1}{2}V_{zz}(t,40)\right). \end{aligned} \tag{20}$$

Taking the sample average of the right hand side of this equation yields

$$\begin{aligned} 1 \quad = \quad & \frac{1}{T}\sum_{t=1}^{T}\left\{\frac{1}{2}\left[\sum_{j=1}^{20}\exp\left(-\left(E[r_t] + \frac{1}{2}\sigma^2\right)2j - m_z(t,2j) + \frac{1}{2}V_{zz}(t,2j)\right)\right] r^L_t\right\} \\ & + \frac{1}{T}\sum_{t=1}^{T}\exp\left(-\left(E[r_t] + \frac{1}{2}\sigma^2\right)40 - m_z(t,40) + \frac{1}{2}V_{zz}(t,40)\right). \end{aligned} \tag{21}$$

We choose the values of ρ_1 and ρ_4 so that they are the solutions to the equations (18) and (21). We do so by first using (18) to express ρ_1 as a linear function of ρ_4 and substituting it into equation (21). We then numerically look for the value of ρ_4 that solves equation (21).