Sovereign Asset and Liability Management

Practical Steps towards Integrated Risk Management

Hans J. BLOMMESTEIN
Head of the Public Debt Management and Capital Market Unit Programmes at the OECD, Paris, France

Fatos KOC KALKAN
Consultant in the Public Debt Management and Capital Market Unit

Increasingly, financial assets, representing foreign exchange reserves, sovereign wealth funds, public pension funds, and structural cash surpluses, are an important component of the sovereign balance sheet. At the liability side, the market value of sovereign debt represents a major claim against most sovereigns. The separate management of these and other sovereign assets and liabilities is in principal sub-optimal.
Indeed, a risk management framework for sovereign liabilities based on an integrated balance sheet or portfolio perspective that would also take into account the risk profile of sovereign assets, would be more effective. We demonstrate this by modelling the cost-risk borrowing strategies of sovereigns in the traditional way and then compare its results with the outcomes of an approach based on the management of both sovereign assets and liabilities (SALM).
We will argue that it is advisable for debt management offices (DMOs) to take into account the risk characteristics of the most relevant sovereign financial assets. Against this backdrop, it will be shown that it is not necessary to review and assess the value of all sovereign assets. To that end, we will (a) consider briefly the financial and risk characteristics of the assets of the following public institutions: central banks (CBs), public pension reserve funds (PPRFs), and sovereign wealth funds (SWFs); (b) review the public governance arrangements of these institutions; and (c) explain how information from (a) and (b) can provide valuable insights into the desirable composition of government debt and ways of reducing financial risk on the government balance sheet, thereby making practical steps towards integrated risk management[1].

I. Introduction and Executive Summary

In recent years, the stock of sovereign financial assets of many governments has increased substantially. Increasingly, financial assets consisting of foreign exchange reserves, sovereign wealth funds, public pension funds, and structural cash surpluses, represent an important component of the sovereign balance sheet. At the liability side, the market value of sovereign debt represents a major claim against most sovereigns. As a result, the composition of sovereign balance sheets has been transformed significantly. The objectives of this paper are: (1) to gain a better understanding of the drivers of this change; (2) to show why it is advisable for debt management offices (DMOs) to take into account the risk characteristics of the most relevant sovereign assets; and (3) to explain that it is not necessary to review and assess the value of all sovereign assets. These objectives constitute practical steps towards integrated risk management largely from a DMO perspective.

Against this backdrop, we will (a) consider briefly the financial and risk characteristics of the assets of the following public institutions: central banks (CBs), public pension reserve funds (PPRFs), and sovereign wealth funds (SWFs); (b) review the public

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governance arrangements of these institutions; and (c) explain how information from (a) and (b) can provide valuable insights into the desirable composition of government debt and ways of reducing financial risk on the government balance sheet.

It will be argued that, in general, it is sub-optimal for sovereigns to optimise the risk-, cost- and return profile of sovereign balance sheets based on isolated strategies for assets and liabilities. Indeed, an integrated risk management framework that would also take into account the risk profile of sovereign assets, would be more effective. We demonstrate this point by modelling the cost-risk borrowing strategies of sovereigns in the traditional way and then compare these results with the outcomes of an approach based on the management of both sovereign assets and liabilities (SALM).

The typical balance sheet of a government consists of future stream of revenues and expenses, CB foreign exchange reserves, sovereign debt stocks, loans and receivables, ownership of enterprises and infrastructural investments (see **Table 1**). In the past decade, the structure of government balance sheets of an increasing number of countries has been changing considerably, driven by persistent fiscal and current account surpluses. Many governments have to-day more liquid (foreign) assets on their balance sheet than required for conventional foreign reserve management. In response, a number of the countries have created special investment funds for the management of this excess liquidity. On the liability side, governments mostly borrow in domestic currency.

In general, sub-categories or items on the balance sheet correspond to separate public institutions and, accordingly, are being managed on the basis of distinct objectives, functions and governance mandates. In this study we shall distinguish the following public institutions: central banks (CBs), sovereign wealth funds (SWFs) [with public pension reserve funds (PPRFs) as a special sub-category], and debt management offices (DMOs). From a financial management perspective, each institution has its own strategies in terms of risk, cost and return, shaped by its objectives and distinct functions.

Central banks, highly autonomous agencies guided by monetary policy targets and financial stability objectives, invest foreign reserves in relatively safe and high-quality liquid assets so as to protect their capital base and to be in a position to provide required liquidity at very short notice (see **Table 2**).

Sovereign wealth funds (SWFs), on the other hand, have much more diverse operations with a wider variety of objectives and associated investment strategies (see **Table 4**). The operational (investment) autonomy of SWFs differs but will in general be lower than that of CBs. Sovereign fund managers can be expected to have a higher risk tolerance (aiming for higher expected returns) than traditional official reserve managers within CBs. As noted, we shall distinguish as a separate sub-category of SWFs the so-called *public pension reserve funds (PPRFs)* (**Table 3**).

Debt management offices (DMOs) are largely driven by cost-risk objectives. As a result, borrowing strategies and liability management are based on a framework for minimising borrowing costs over the medium-term subject to a desirable level of risk (Blommestein, 2002). In most OECD countries, the operational autonomy of DMOs has increased in the past decade or so.

Although the asset and/or liability strategies of the different agencies may be optimal in terms of local risk-returns/costs terms, this will in general not be the case from a total sovereign balance sheet point-of-view or central risk perspective. For example, the outcome of some strategies may leave the overall sovereign balance sheet more vulnerable to financial risks than is desirable or necessary. For example, the government's balance sheet risk would increase if it invested its foreign currency reserves in (short-term) dollar deposits and financed the investment with long-dated borrowing in a different currency. This would result in an interest – and currency mismatch.

A better management of the risks on the sovereign balance sheet can be achieved by co-ordinating in some form (including by simply exchanging information) the investment strategies of assets with government liability management. We will explore this approach from the perspective of the DMO. DMOs are well placed to be involved in managing the risk profile of the sovereign balance sheet as a whole. Already now, public debt managers often act as the treasury/capital market advisor for the entire government. Moreover, in some countries such as New Zealand, the DMO has already explored various ways of jointly managing sovereign assets and liabilities (SALM).

The increase in sovereign financial liquid assets makes an analysis of the effectiveness of various SALM-approaches more important and urgent. A more systematic and integrated government balance sheet approach would assist debt managers to gain a better understanding of the entire picture of risks associated with financial assets and liabil-

ities. This SALM-approach in turn will facilitate designing a comprehensive risk-based debt management strategy that can provide valuable, additional insights into the desirable composition of the portfolio of government debt as well by identifying natural hedges (or constructing financial hedges) that would reduce financial risks on the government balance sheet.

II. A Closer Look at the Composition of Sovereign Balance Sheets

Companies routinely construct balance sheets representing a snapshot of their financial conditions at a specific point in time. Generally, governments do not produce comprehensive balance sheets. Instead, they publish annual fiscal budgets which are based on incomes and expenses over a certain period of time. But for a comprehensive sovereign risk analysis, both budgets and balance sheets provide essential information on (a) assets, liabilities and the net worth of the government (in stock terms), as well as (b) cash flows driven by underlying changes in assets and liabilities. This type of analysis offers valuable insights into the (potential) impact of changes in interest- and currency rates on the (market) value of sovereign assets and liabilities. It is also possible to obtain information on changes in risk appetite. For example, the diversification from low-yielding fixed income securities into assets with higher expected returns is a reflection of a higher sovereign appetite for risks.

Against this backdrop we will take a closer look at the general government balance sheet as well as the components of sovereign balance sheets that are being managed on a *sub* portfolio basis. A typical government balance sheet can be expressed in terms of the following main assets and liabilities (**Table 1**).

Table 1: Main Components of the General Government Balance Sheet (*)

Assets	Liabilities
Cash invested (1)	Payments Owing to Suppliers
PV of Future Fiscal Revenues (2)	PV of Fiscal Expenditures (2)
Foreign Exchange Reserves Held by the CB	Market Value of Government Debt Stock
Sovereign Investment Funds	PV of Contingent Liabilities (5)
Investments in SOEs (3)	
Investments in Infrastructure (4)	

(1) Deposits at the central bank and in domestic bank accounts operated by government agencies; foreign currency liquidity invested by the debt office.
(2) The present value (PV) of revenues and expenditures of the sovereigns gives the stock value of future income- and expenditure streams.
(3) State Owned Enterprises (SOEs) are the companies which are partially or fully owned by governments.
(4) Commercial property and other forms of real estate.
(5) Both explicit and implicit contingent liabilities become actual liabilities of the government after a particular event occurs.
(*) Based on G. Wheeler (2004).

Typically, the major financial assets on the government's balance sheet are the present value (PV) of future tax revenues, CB foreign reserves, and stakes in state entities and public financial institutions including the IMF and WB. Liabilities, on the other hand, primarily consist of the PV of future government spending and the market value of the stock of government debt.

The balance sheet of the general government represents by definition the consolidation of individual balance sheets of various public institutions that are being managed on a sub-portfolio basis. These sub-portfolio balance sheets are being managed on the basis of each individual institution's objectives, functions, as well as legally and politically sanctioned mandates.

Table 2: Central Bank Balance Sheet (*)

Assets	Liabilities
Foreign assets (Claims on Non-residents)	Foreign liabilities (Claims on Non-residents)
Claims on the Government	Base Money
Claims on Deposit Banks	CB Securities
Claims on other sectors	Capital Reserves
Other Assets	Other Liabilities (inc. revaluation accounts)

The Central Bank's primary objective is price stability. Its balance sheet is composed of domestic and foreign currency assets and liabilities (**Table 2**). As investors, central banks invest their foreign reserves normally in relatively safe and liquid assets in order to protect their principal capital and to be in the position to provide liquidity at short notice. However, during the last decade we have been witnessing an important change in investment strategy in response to excess levels of reserves in some countries. Many CBs have started to invest these excess reserves in asset classes with higher expected returns. In many countries, foreign reserves are divided into a *liquidity portfolio* (held in short-term or floating-rate securities and deposits) and an *investment portfolio* that is invested in longer-maturity and riskier assets that are expected to generate higher expected returns.

More in general, high commodity prices (especially for oil) accompanied by large trade- and current account surpluses have led to a significant increase in the amount of assets under sovereign management. In response, many governments have set-up sovereign investment funds to manage those assets, including China, New Zealand and Russia. A recent OECD study (Blundell-Wignall a.o., 2008) makes a distinction between SWFs and Public Pension Reserve Funds (PPRFs). In contrast to sovereign funds whose liabilities are often not clearly defined, the PPRFs are created with the objective of (directly or indi-

rectly) contributing to financing public pensions and other social security benefit programmes (**Table 3**). In the latter case, the size and nature of unfunded future social security payments and defined benefit pension liabilities can be an important factor determining the investment strategy. This means that PPRFs follow (implicitly or explicitly) *sovereign liability driven investment* (SLDI) strategies.

Table 3: Public Pension Reserve Fund Balance Sheet (*)

Assets	Liabilities
Current Assets	Pension and Other Social Security Promises
Future Contributions	
Future Returns	

(*) Based on Muralidhar S. Arun (2001).

Table 4: Hypothetical Sovereign Wealth Fund Balance Sheet

Assets (*)	Liabilities (**)
Fixed Income Investments	Domestic Debt
Equity Investments	
Other Investments	

(*) Assets can be both in domestic- and foreign currencies.
(**) Liabilities may vary depending on the source of funding and objectives of a fund.

The relatively narrow mandates of PPRFs and foreign reserve managers have a direct influence on the investment strategies they can prudently pursue. In contrast, many sovereign investment funds have more freedom to pursue higher expected return (more risky) strategies. By adopting a higher risk tolerance and higher expected return strategy, they can follow a broader range of investment styles (including absolute return strategies) and invest in a wider range of instruments, including relatively illiquid ones. Moreover, many sovereign funds tend to invest outside the domestic financial market. As a result, a broader and more complex range of sovereign assets can be found on their sovereign balance sheets. Given the risk implications of these assets for sovereign balance sheets, the characteristics of these assets will be examined in more detail in the next section.

On the liability side of the general government balance sheet, debt stocks generally dominate. The main objective of debt manager is to arrange as efficient as possible the financing needs and the day-to-day payment obligations of the government. Borrowing strategies are based on a minimum cost objective subject to an acceptable level of risk (Blommestein, 2002).

Risk-based debt management strategies are essential for controlling a government's balance sheet exposure. From this risk perspective, both the level and composition of the debt portfolio are very important (Blommestein, 2005). For example, the inability of some governments in emerging markets to borrow in their own currency ("original sin") making their balance sheets vulnerable to exchange rate shocks because of currency mismatches on their balance sheets (Eichengreen a.o, 2003). In response, a growing number of sovereigns in emerging markets have made important progress in developing domestic currency government bond markets. This in turn prompted DMOs to implement debt management strategies that incorporate borrowing programmes, leading to less currency mismatches because of the greater reliance on domestic currency bonds (Blommestein Santiso, 2007). In other words, the existence of a well-developed domestic fixed-income market with appropriate risk valuation systems is important for implementing a risk-based debt management strategy. Vice versa, implementing modern, risk-based debt strategies contribute directly to the development of efficient domestic bond market (Blommestein, 2002):

"... The focus on debt management and the upgrade of debt management capabilities, as well as the establishment of interest rate, liquidity and currency benchmarks have helped to improve the transparency, predictability, and liquidity of fixed-income debt markets in OECD countries, including corporate bond markets..."

III. Trends in Sovereign Financial Assets and the Growing Importance of SWFs

III.a. Central Bank's Foreign Exchange Reserves

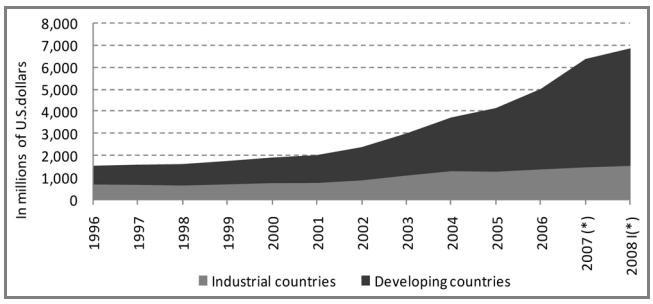
Central Banks are holding a certain amount of foreign exchange reserves in their *liquidity portfolio* (consisting of short-term or floating-rate securities and deposits) for interventions in the FX market as part of their monetary policy operations as well as to absorb shocks during crises as part of their financial stability mandate (IMF, 2003).

The size of the liquidity portfolio corresponds in principle to the so-called optimal reserve level. However, there is a wide range of views on what constitutes this optimal reserve level. Before the 1990s, optimal levels of reserves were defined via the "three months of imports" rule[2]. After the experience of the 1990s, when financial crises were triggered by a sudden drying-up of capital inflows, the ability of economies relying on international

2. This simple rule of thumb states that the level of reserves should be enough to cover at least three months of imports.

borrowing to service the resulting external debt became a central policy issue. Consequently, the optimal level is commonly defined as the level that is sufficient to cover total short-term external debt in crisis situations[3]. However, there is evidence that in some jurisdictions the actual level of FX reserves is far beyond the optimal levels inferred from these rules. International reserves increased significantly over the last decade, with reserves reaching about $6.4 trillion at the end of 2007, up from $1.4 trillion in 1995 (**Chart-1**). In the same period, the share of the developing countries in total reserves increased from 52% to 77%. The notion that excess reserves are kept in low-yielding assets in the liquidity portfolio has prompted the creation of *investment portfolios* that invest in higher-yielding, riskier assets with longer-maturities than those in the liquidity portfolio.

Chart 1: Official Foreign Exchange Reserves (*)

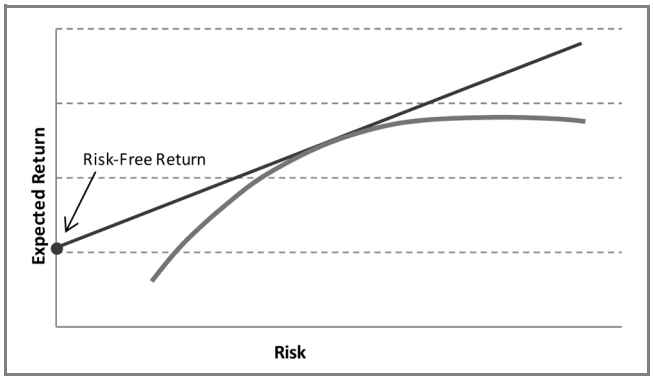


(*) Preliminary
Source: IMF Statistics Department Currency Composition of Official Foreign Exchange. Reserves (COFER) database.

In general, the investment decisions regarding CB's asset management allocations are taken at two levels: strategic and tactical. The long-term orientation of asset allocations is determined at the strategic level, while short-term deviations from the long-term goal are made at the tactical level (in order to improve the return on assets). At the strategic level, CBs are expected to invest their reserves first and foremost on the basis of their monetary policy and financial stability objectives. Since these assets are expected to be available at short notice, they are held in liquid and secure asset classes such as high sovereign bills and bonds.

However, as noted, excess levels of reserves have created increasing pressure on central banks to invest in higher return assets, including mortgage and asset-backed securities, highly-rated corporate bonds and also public and private equity. In terms of risk preferences, this suggests that reserve managers move to the right on the efficient frontier (**Chart 2**). The BIS Annual Report of 2007 notes that the large increase in foreign exchange reserves in recent years has shifted the balance towards more return-oriented strategies, reflecting the trend to divide international reserves into two sub-portfolios: liquidity and investment. The actual weight of these sub-portfolios depends on the extent of excess reserves and the long-term orientation of the asset allocation strategy. For example, the investment portfolio of Norges Bank (Norway's central bank) is managed with a long-term horizon with an equity share of 40 percent.

Chart 2: Efficient Frontier



The currency composition of the reserve portfolio normally reflects the objectives and the weight of trade partners. Moreover, an increasing number of CBs take into account the currency composition of sovereign debt while determining their reserve management strategy. Norway, for example, sets aside an immunization portfolio that is equivalent to its government foreign currency debt. In some countries, like New Zealand and Australia, international reserves are financed through external borrowing based on an SALM approach (see below for further details).

III.b. Sovereign Wealth Funds and PPRFs

The number and size of sovereign funds have been increasing rapidly. Today, the number of the wealth funds stands at more than 40 (and is still growing) and the total market value of assets under management is estimated at 2.5 – 3.5 trillion dollars (Ervin, 2008b).

Although there is a great diversity in SWFs (reflecting differences in risk appetite, different sources of revenue, objectives, liabilities, investment styles, and so on), sovereign investment funds are in general not as highly leveraged as for example some hedge funds. Many of them are subject to investment rules in terms of certain asset classes

3. The Guidotti-Greenspan rule of reserve adequacy states that countries should hold enough reserves to cover at least their external liabilities falling due within one year.

or currency exposures. However, they can invest in a broad range of asset classes including government bonds, agency and asset-backed securities, corporate bonds, equities, real estate, derivatives markets, alternative investments, and foreign direct investment[4]. In terms of currency composition, sovereign funds invest mostly in foreign currencies. Most SWFs place the larger part of their assets abroad, mainly to reduce inflationary pressures, as well as to avoid or mitigate excessive appreciation of their currency and other Dutch disease symptoms.

As noted, the OECD makes a distinction between "regular" SWFs and Public Pension Reserve Funds (PPRFs). PPRFs are set-up with the objective of contributing (directly or indirectly via the budget) to the financing of public pension liabilities and related social security promises. In this way they strengthen the long-term sovereign balance sheet. Examples of PPRFs include the Australian Future Fund, the Irish National Pension Reserve Fund, and the Norwegian Government Pension Fund. "Regular" SWFs, on the other hand, have usually a more wide range of objectives with multiple goals. They can be categorised on the basis of the following broad objectives (Ervin, 2008a):

– ***Stabilisation funds:*** Stabilisation funds aim to cushion short- and medium-term government revenue volatility (*e.g.*the Chilean Economic and Social Stabilization Fund and the Venezuelan Investment Fund for Macroeconomic Stabilization Fund) and to smooth government expenditures streams across revenue booms and busts.
– ***Savings funds:*** Savings funds aim to accumulate public wealth for use by future generations to ensure intergenerational equity (for example, a savings fund could finance public investments long after the natural resources have been depleted).
– ***Reserve investment funds:*** In some countries, like China, SWFs aim to preserve and boost the purchasing power of foreign reserves (but with no explicit liability attached). These funds basically manage excess reserves to achieve an investment return that will preserve at least the long-term purchasing power of the reserves.

With respect to revenue sources, SWFs fall into three categories (Ervin, 2008a): (a) natural resource-based funds, (b) foreign exchange-based funds and (c) fiscal funds. Natural resource-based or commodity funds are financed via commodity export revenues (in case of natural resources owned by the government) or via taxation. Almost two-third of SWFs is commodity- (mostly oil) based funds including the Abu Dhabi Investment Authority (ADIA) and the Kuwait Investment Authority (KIA). Commodity funds serve different purposes, including stabilisation of fiscal revenues, inter-generational savings, and sterilization of international inflows.

Foreign exchange-based funds are financed via transfers of "excess" sources of foreign exchange reserves (*e.g.*, China and New Zealand). Large current account surpluses (in some cases complemented by capital account surpluses) have enabled non-commodity exporters (particularly in Asia) to transfer "excess" foreign exchange reserves to stand-alone SWFs.

Finally, some SWFs were created via proceeds from privatisation or structural government budget surpluses. These fiscal funds include Temasek Holdings of Singapore. The Australian government transfers its budget surpluses into a so-called "Future Fund"; this fund aims to strengthen the sovereign balance sheet by financing future public service superannuation liabilities.

Both the type of revenue source and objective(s) of the SWF can be expected to affect its investment strategies in terms of asset allocation, maturity and currency choices. Saving funds have a long-term approach, while stabilisation funds need to be more liquid and adopt a more conservative investment style. In cases where investment funds are financed through domestic debt, a more aggressive investment strategy should be followed, since the return on sovereign assets is expected to be higher than the cost of public borrowing.

In the remainder of our study, we will analyse the management of SWFs from an SALM perspective, suggesting in effect that the investment strategies of SWFs should be effectively coordinated (directly or indirectly) with the financing operations related to other items on the balance sheet of the government. As explained above, the assets of many SWFs are in practice managed primarily at the sub-portfolio level. This may be clearly sub-optimal since consolidated portfolio considerations are not taken into account – for example, in a situation where the budget deficit is being financed at high interest rates while at the same time SWFs invest in low-return assets. Indeed, in particular in countries with a high sovereign debt burden, the cost of borrowing is often higher than the return on assets. This is clearly a sub-optimal situation. Moreover,

4. The asset and currency composition of sovereign wealth funds are estimated as: 23% in bonds, 55% in equities, 7% in real estate, 7.5% in hedge funds, 7.5% in private equities; 38% in US Dollar, 14% in Euro, 14% in Pound, 10% in JPY, 24% in other assets (IMF, 2008).

from a sovereign risk perspective, high foreign currency-denominated debt ratios increase the vulnerability of the sovereign balance sheet. In this situation, the government may find it advantageous to use sovereign assets to liquidate outstanding foreign debt by making early repayments. For example, in 2005 almost USD 23.6 billions from Russia`s Stabilization Fund was used to make early debt payments to the IMF and the Paris Club.

IV. Optimal Sovereign Asset & Liability Management (SALM): an Integrated Risk Management Perspective by the DMO

Sovereign balance sheets are getting increasingly complex in terms of risks while at the same time financial assets have grown strongly in many jurisdictions. As a result, the consolidated sovereign balance sheet as a whole needs more careful attention so as to avoid possible significant mismatches. Mismatches in financial characteristics of sovereign assets and liabilities make sovereign balance sheets more vulnerability to a wide range of financial risks. At the same time, the growing size and diversity of financial assets also offer new opportunities for lowering government borrowing costs.

These perspectives make an integrated SALM approach of greater importance than in the past, whereby the investment horizon, the maturity of debt, as well as currency- and interest rate composition of assets and liabilities are determined on a holistic, balance sheet basis.

One of the principles of finance theory is the "direct" relationship between risk and return: investments that promise higher returns also carry greater risks that losses will materialise. In the case of public investments, losses are ultimately paid by taxpayers, although their control over investment decisions is normally very limited. It is widely argued that the government should therefore be risk averse in its financial management (reflecting the median voter's preferences; Wheeler, 2004):

"Governments tend to be risk averse; they have a low appetite or tolerance for risk. Accordingly, they generally seek to avoid making policy decisions, including financial ones, where unfavourable outcomes can have serious negative consequences. Governments' preference for less risk is often revealed by their decisions to downsize their balance sheets, privatize state-owned entities, reduce their contingent liabilities and by their conservatism in analyzing private sector proposals for sharing risk."

The ALM framework for risk management has been in use in financial markets for a few decades, especially in the banking sector. This approach aims to maximise profit or net worth under conditions of uncertainty, with the ALM analysis identifying and minimising mismatches between assets and liabilities on the balance sheet of the bank. In this way, the asset side of the balance sheet is immunised to risks from the liability side of the balance sheet, and vice versa. In practice, there are several techniques to analyse risk characteristics of balance sheet items such as sensitivity-, gap- and duration calculations.

Serious government's balance sheet mismatches render economies vulnerable to external shocks and, in turn, can become a major source of damaging volatility for the international financial system. In particular the inability of emerging markets to borrow in their own currency ("original sin") has led to significant currency mismatches on their national balance sheets. But even when original sin can be overcome several emerging economies have weak balance sheets caused by an over-reliance on short-term domestic debt, floating-rate debt, and/or foreign-currency debt. The resulting mismatches make the balance sheet vulnerable to adverse interest rate -and/or exchange rate shocks, leading to a rapid increase in debt-servicing costs and debt stocks (in domestic currency). This in turn means that net worth will dramatically fall in local currency terms. The basic idea of the sovereign ALM approach is to choose a sub-portfolio of sovereign liabilities which matches as much as possible the financial characteristics of the sub-portfolio with sovereign assets. This matching approach will reduce a country's vulnerability to international financial shocks.

The objectives of most sovereign debt managers in the OECD area are limited to the cost and risk dimensions of a debt portfolio, while sovereign assets are not (directly) taken into account (Blommestein, 2002, 2006). However, as noted, the rapid growth of sovereign financial liquid assets has increased the potential importance for sovereign debt managers to focus on the entire government balance sheet and to adopt a SALM approach. This would allow in principle a more comprehensive strategy to reduce balance sheet vulnerabilities.

Against this backdrop, some countries have begun to take into account (part of) the asset structure and associated risks when designing the optimal debt strategy (Blommestein, 2006). Moreover, in many OECD countries, short-term financial assets such as cash deposits are already taken into account by debt managers (*e.g.* Australia, Hungary and Turkey). In New Zealand, the

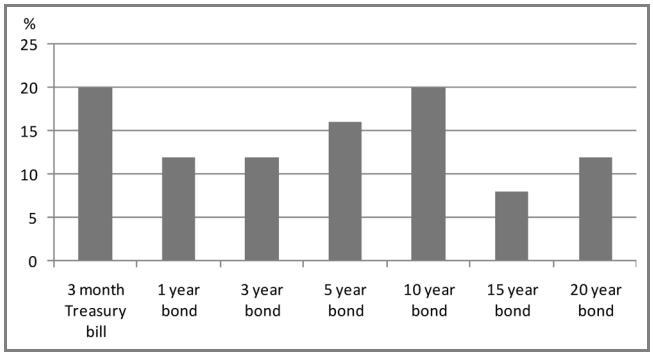
DMO has taken additional steps by taking both short- and long-term financial assets and non-financial assets into consideration. The objective of the NZDMO is defined as "... to maximize the long-term economic return on the Government's financial assets and debt in the context of the Government's fiscal strategy, particularly its aversion to risk...".

In the next section, we discuss a CaR model based on a synthetic portfolio for designing an optimal borrowing strategy. The main aim of the modelling exercise is to demonstrate the difference between a pure liability approach and one that takes into account (some of) the financial characteristic characteristics of a sovereign balance sheet as a whole.

IV.a. A CaR Exercise Based on a Synthetic Debt Portfolio

The Cost at Risk (**CaR**)[5] model is a widely used tool for investigating the trade-off between cost and risk factors associated with different borrowing strategies. Our CaR analysis is based on a hypothetical debt portfolio with different instruments so that we can illustrate different cost-risk characteristics (**Chart 3**). It is further assumed that the debt office borrows to finance the budget deficit so that the nominal level of debt stock remains the same at the end of each simulation period. Cost is defined as the "cost of borrowing" (interest payments), while risk refers to the volatility of costs. Interest costs are measured in accrual terms[6] in order to facilitate the comparison of costs and alternative strategies over different periods of time.

Chart 3: Composition of the Hypothetical Debt Portfolio



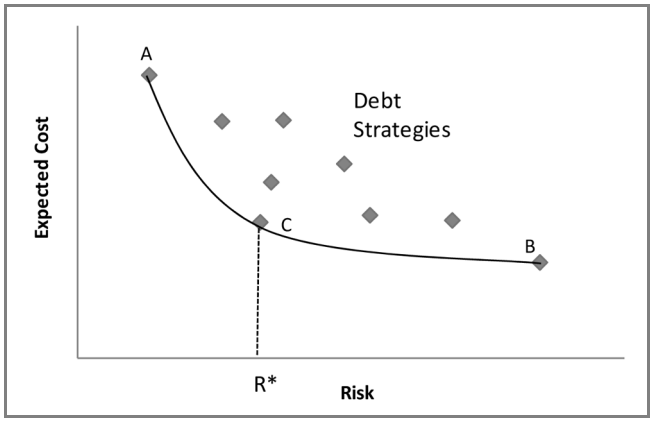
Our simulation model consists of two modules: **module I** for forecasting macroeconomic variables; and **module II** for simulating debt management strategies. A vector auto regression (**VAR**)-model is employed to forecast the key macroeconomic variables including interest rates. A number of borrowing strategies were simulated over a 5 year period in order to demonstrate the effects of the choice of maturity, currency and borrowing instruments. We also studied two extreme cases: financing 100-percent in short-term paper and 100-percent in long-term instruments.

IV.b. The Results of the Simulation Model

The results of our stochastic simulation are based on (a) the forecasted macroeconomic variables and (b) hypothetical debt portfolios driven by different borrowing strategies. Since we are keeping the nominal level of debt stock constant, the expected interest costs are not reduced drastically over the simulation period. Via this simple illustrative exercise we can generate the expected cost and risk for each strategy. The simulation results are used to construct a medium-term efficient frontier (**Chart 4**)[7]. The efficient frontier shows the fundamental cost and risk trade-off in government liability management, allowing debt managers to compare different strategies in a rigorous fashion. Each point on the efficient frontier represents the lowest cost portfolio for a given level of risk.

5. In practice, there are two different definitions. Absolute CaR indicates the maximum cost for a certain period with a probability defined at a certain percentile level. Relative CaR, on the other hand, is the difference between absolute CaR and expected cost (mean value). The latter concept specifies the maximum increase in the costs for a given period and at a specific percentile level.
6. Interest payments can be calculated in two different ways: cash and accrual-based. The cash-based approach measures interest costs when they are paid; while accrual based valuation records them when they occur.
7. Expected interest cost is the mean value calculated using interest-cost scenarios in CaR. Absolute CaR is calculated as the 95th percentile of the interest-cost scenarios in the model.

Chart 4: Efficient Frontier

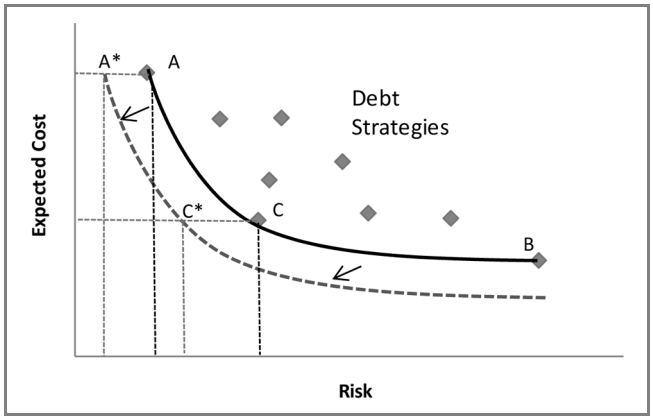


Strategy "**A**" consists of 100-percent 20-year bonds. This strategy has lower interest-rate risk but also higher costs than the other strategies on the efficient frontier. The other extreme case is borrowing strategy "**B**" that has lowest expected cost with 100-percent short term Treasury bills in domestic currency. By moving from **A** to **B** (that is by decreasing long-term securities in the portfolio) we get much lower expected interest costs but at the expense of much higher interest-rate risk. Strategies that include indexed-linked bonds lengthen the maturity profile at an intermediate level of risk (relatively low standard deviation). Foreign currency borrowing, on the other hand, increases risk but reduces expected borrowing cost. Along the efficient frontier, the optimal combination of costs and risk is presented by point **C**, given the preferred level of risk **R***. In comparison to portfolio **A**, strategy **C** entails less long-term borrowing and more short-term securities and/or foreign bonds. In practice, the selected optimal debt strategy reflects the risk tolerance (**R***) of the government.

IV.c. Implications for CaR Modelling of Incorporating Sovereign Assets

The selection of an optimal debt strategy may change when the asset structure is taken into account via its impact on the risk profile of the sovereign balance sheet. This perspective has become more important than before in view of the increasing number of countries that have sizeable foreign currency assets including reserves and other liquid instruments. Taking this information into account has a potential important influence on the design of risk-based debt management strategies. For instance, a switch from borrowing entirely in terms of 100-percent 20-year bonds (in domestic currency) to covering some part of the financing needs via foreign currency borrowing. Usually the reason for foreign borrowing operations is to attract funds at lower costs than in the domestic market. But it is necessary of course to face the trade-off of higher (currency) risk. In **Chart 5**the switch in borrowing strategy is illustrated as follows. First, the reduction in long-term borrowing (domestic currency) is replaced by foreign-currency debt resulting – on balance – in lower borrowing costs but, at the same time, leading to an increase in (currency) risk. This trade-off is expressed by moving on the efficient frontier from borrowing strategy **A** (100-percent in 20-year domestic currency bonds) to strategy **C** (a mix of 20-year domestic currency bonds and foreign currency bonds). However, when sovereign assets (invested in foreign currency instruments) are added to the equation, then it is possible (in case foreign currency liabilities are partly or completely matched by foreign currency assets) that lower costs are associated with a lower level of risk. This is indicated in **Chart 5**by moving from strategy **C** to strategy **C*** (this encompasses a mix of 20-year domestic currency bonds and foreign currency bonds but explicitly taking into account that there are sovereign assets on the balance sheet denominated in the same foreign currency as the liability): that is, a shift of the efficient frontier to the left[8]. In other words, when foreign assets are taken into account, foreign currency borrowing operations could in fact be part of an optimal strategy with lower costs and acceptable currency risk on the government's balance sheet as a whole. In fact, the reserve management of New Zealand is based on this strategy, whereby international reserves are financed through issuing foreign currency debt.

Chart 5: Impact of Sizeable Foreign Assets on Efficient Frontier



Another case study is the following. Assume that sovereign assets consist of long-term securities while sovereign liabilities have a short maturity (strategy **B** in **Chart 5**). In

8. For the sake of simplicity, the curvature of the efficient frontier has been kept the same. In reality, the curvature is likely to change.

that case, even though borrowing at the longer-end of the yield curve is associated with higher costs (strategy **A** or **C**), this may actually be the desirable borrowing strategy (so as to avoid balance sheet mismatches for a given level of interest costs).

V. Conclusion

This paper discussed the main reasons why it is sub-optimal for sovereigns to manage their balance sheet via a non-integrated risk review. To illustrate the downside of a non-integrated risk approach, we have used a **CaR** model based on hypothetical debt portfolios. Case studies were used to demonstrate that taking into account the influence of the size and nature of sovereign financial assets on the overall risk profile of the government's balance sheet, can improve the cost-risk trade-off of borrowing strategies.

It was also shown that, given the financial characteristics of a sub-portfolio of sovereign assets, sovereign borrowing strategies can play an important and flexible role in controlling (potential) risks at both sides of the government balance sheet.

Assessing the influence of sovereign assets should also include looking for *natural hedges* in the asset and liability portfolio of the government. For example, a natural hedge can be constructed by ensuring that the currency and interest rate composition of government borrowing used to finance forex reserves is matching closely the currency and interest rate structure of the reserves (Wheeler, 2004). In addition, the government (DMO) should investigate the need for *financial hedges* for reducing market risk (greater certainty and lower cash flow volatility related to exposures), taking into account transaction costs and credit risks involved (related to the use of these hedges).

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