

# SOVEREIGN DEBT MANAGEMENT IN AN ASSET-LIABILITY MANAGEMENT FRAMEWORK

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## **Introduction**

Over the last ten years, the NZDMO has undertaken a considerable amount of work analysing the structure of the government's liabilities within an asset-liability framework. The objective of this work has been to reduce the risk and cost of the public debt. This paper outlines the approaches we have explored, the difficulties encountered and a context for the use of an asset-liability management framework.

After covering early work on the net foreign-currency debt, there is a consideration of the relevant assets and liabilities when analysing sovereign debt portfolios. Three approaches are covered:

- the entire economy;
- all government activities; and
- a published balance sheet, based on generally accepted accounting practices.

More recent internal research is then presented, where the focus is on assets and liabilities with measurable returns and costs, using a modern portfolio theory framework.

To provide a context in which the NZDMO has used asset-liability management, there is a discussion of the other important principles for prudent debt management.

Finally, the paper touches on the how an asset-liability management framework can contribute to the more efficient management of risk, for a given cost, across the entire balance sheet of a sovereign.

## **Early Work**

In the late 1980's the NZDMO, as with several other countries, used mean-variance modeling to help it with debt composition issues. At the time over half of the public debt was denominated in foreign currencies and the objective was to identify a portfolio that had a low volatility in New Zealand dollar terms.

The government did not have a comprehensive picture of its assets and non-debt liabilities, but the foreign-currency reserves were taken into account in the analysis. The optimisation work therefore focussed on a net foreign-currency debt portfolio and

represented the earliest attempt, albeit modest, to employ an asset-liability management framework.

To some extent the process was simplified by the fact that the exchange rate policy was a clean float, meaning that reserves levels did not fluctuate a great deal. Periodic changes were made to reserves levels and composition, but these were strategic decisions with reasonable lead-in periods so appropriate adjustments could be made to the liabilities, if required.

The mean-variance modeling work provided useful information on currency composition, but the NZDMO was uncomfortable with the results in respect of interest rate risk for two reasons:

- portfolio compositions suggested by the modeling were unstable, depending on the period under review; and
- questions arose as to whether the strategic composition was appropriate given that there was only limited information available at the time on the asset side of the Government's balance sheet.

The work at the time demonstrated that the foreign-currency reserves were an important driver of risk in the balance sheet, with risks that were a "mirror image" of part of the foreign-currency liabilities. By using these hedging qualities the NZDMO was able to better manage the Government's overall risk position. To have undertaken an optimisation on the foreign-currency liabilities alone would have resulted in a "fine-tuning" of one element of the government's foreign exchange risk, but not the wider picture of foreign-currency currency exposure. In such circumstances there is a risk that the outcome could result in unintended and unnecessary exposures.

### **What are the Relevant Assets and Liabilities When Considering Sovereign Debt Management?**

By the early 1990s, the DMO was extending the analysis of its debt portfolio to include other assets. The objective was to create a portfolio of liabilities with similar financial risk characteristics as the assets, in order to reduce the susceptibility of the balance sheet to shocks. While this might be relatively straight-forward for a financial institution, for a government there are a number of complexities. First there is an issue of which assets and liabilities are relevant.

### **The Entire Economy**

One approach is to argue that the government concern itself with constructing a debt portfolio with the aim of hedging the economy as a whole against shocks to national income or net worth. Under such an analysis, domestic debt is regarded as an internal transfer, and the objective is to determine a configuration of net external liabilities that would fall in value if a shock negatively impacted on collective economic balance sheets of

residents. However, there are major problems that would probably render such an approach ineffective:

- information about the nature of risks in the economy and the degree and nature of private hedging mechanisms is highly dispersed and potentially costly to collect; and
- perverse outcomes could result, as private individuals might observe the government's hedging actions and modify their own arrangements accordingly.

### **Government Perspective**

A second, and narrower, way to think about the issue is to consider the assets and liabilities that relate only to the government as an entity. Even if public accounting conventions do not extend to the publication of a balance sheet, it can be constructed in a notional manner.

Some commentators would argue that the government's largest asset is the power to tax, and that this should be included in the analysis, alongside the more conventional items such as publicly owned infrastructure. In most economies this asset (in present value terms) dwarfs others by a large margin. The objective of such an approach would be to structure total public debt so as to hedge against fluctuations in the tax base with a view to stabilising tax rates over time, to reduce the dead-weight costs of taxation.

An assumption of this approach is that government expenditure is exogenous to the analysis and constant in real terms. Shocks to the economy and the government's fiscal position are therefore managed through changing tax rates or through debt financing. This assumption would appear to be too strong – government expenditures are not exogenous in the medium term and indeed at the time in New Zealand the government was reducing expenditure to strengthen the fiscal position and avoid raising taxes.

In the literature the interrelationship between optimal taxation and debt management has been examined by a number of authors. It is not my intention to cover the various strands of this debate. The work that NZDMO undertook in the early 1990s was focussed mostly around the exchange rate sensitivities of the government's revenue flows, given the magnitude of the foreign-currency public debt. This work showed that the revenue flows had little sensitivity to the exchange rate, and supported moves to reduce the level of foreign-currency debt.

Work in this area also considered the role of the debt portfolio in mitigating the impact of shocks to the economy and therefore the likelihood of having to increase taxes. Negative supply shocks (such as an oil price rise) have the effect of increasing inflation and decreasing real income, therefore leading to a deterioration in the fiscal position. To reduce the need to increase taxes in the face of such an event, a debt portfolio comprising nominal long-term debt is preferable to inflation-indexed debt.

In the case of a negative demand shock (such as a tightening of monetary policy) both output and inflation would decelerate, and the government's fiscal position would deteriorate. In these circumstances, inflation-indexed debt servicing costs would fall and help offset the deteriorating fiscal position.

In New Zealand it is not clear which shocks would dominate in the future, although supply shocks would be likely to be longer lasting. Therefore some mix of inflation-indexed and nominal debt would be appropriate.

### **Balance Sheet Approach**

A third way to define the relevant assets and liabilities is to adopt definitions that accord with generally accepted accounting practice. In such a manner, the asset side comprises physical infrastructure, lending by government, securities, receivables etc. In addition to debt, liabilities would include payables, provisions, unfunded pension liabilities, etc.

From December 1991, on a six-monthly basis, the Government has been required to produce consolidated financial statements based on generally accepted accounting practices. This replaced the traditional cash-based accounting practices.

This opened the way to the possibility that the Government's risk might be reduced by matching the risk characteristics of the Government's liabilities with those of its assets, as published in the Balance Sheet. If such matching were possible, liability structures would provide natural hedges against shocks to the Government's balance sheet, reducing the volatility of the Government's net worth.

In 1993 the NZDMO commissioned consultants to quantify as far as possible the risk characteristics of the assets in the Government's balance sheet. The objective was to gain better insight into the Government's overall balance sheet risk and to develop a stronger conceptual framework for strategic debt management. This framework would explore whether it was feasible to match the structure of the Government's assets with its liability portfolio in order to dampen the impact of interest-rate and currency movements on the Government's net worth.

Sizeable challenges needed to be confronted, particularly given that many of the Government's balance sheets assets were physical assets in the nature of public goods which did not generate cash flows.

The consultants were asked to derive a methodology for calculating the risk characteristics (real duration and sensitivity to exchange-rate movements) of the three largest real assets in the Government's balance sheet: highways, equity in the government-owned electricity system and land and buildings.

Duration of the physical assets was based on calculations of the cash flows or benefits guaranteed by the assets, the discount rate and the remaining asset life. Asset duration may be calculated if the cash flow or benefits are assumed to be the same in each future period, and the discount rate and maturity of the asset is known. A benefit of this approach was that it was not necessary to specify the absolute level of benefits flowing from the assets. It was sufficient to forecast the likely growth rate of benefits.

To estimate the duration of the national highway system, for example, technical data was gathered on the economic life of the asset. Scenarios were developed based on different growth rates in services and the real discount rate. These scenarios were combined to produce an overall weighted duration of around 15 years.

It was decided, however, not to complete the work for a range of reasons:

- the poor quality of the data on the Government's assets resulted in large standard errors around the estimates of the interest-rate sensitivity of the assets;
- there was insufficient information on the extent to which the assets were nominal or real in nature. This is important because changes in nominal interest rates caused by changes in inflation expectations will change the value of nominal assets but not real assets; and
- there were concerns about the legitimacy of the assumption used that cash flows or benefit streams were insensitive to interest-rate changes. While this assumption made the estimation problem more tractable, it was difficult to know how strong an assumption this was.

Nevertheless, some important conclusions did emerge from this work:

- the duration of the assets tended to be quite long, lending weight to the case for issuing longer-dated debt;
- some of the Government's assets were real assets (i.e., these generated cash flows which were indexed to movements in inflation), the value of which was sensitive to changes in real interest rates, implying there was a strong case for issuing real, or inflation-indexed, debt; and
- the asset prices were not significantly sensitive to exchange-rate movements, implying that holding foreign-currency debt in the Government's debt portfolio introduced significant variability to the Government's net worth.

This study suggested that the NZDMO should reconfigure its debt portfolio over time to remove foreign-currency exposures and achieve a longer duration of New Zealand-dollar debt, including inflation-indexed securities. The conclusions that were reached from this work have some concordance with those arising from a "tax-smoothing" perspective, described above.

These changes were implemented by the mid-1990s. Since then, the emergence of fiscal surpluses have resulted in a re-evaluation of the domestic debt maturity profile, with potential repayment profiles taking a greater role.

### **Applying Modern Portfolio Theory to the Balance Sheet**

In more recent internal research, the focus has been on returns and costs of assets and liabilities, using the framework of modern portfolio theory. In contrast to earlier work, it does not include physical assets that do not directly produce returns. The technique provides a framework to maximise return for a given level of risk tolerance. The objective is to better understand the nature of the risks on the Balance Sheet and to inform decision-making on overall composition from a government-wide perspective, as opposed to an entity-specific perspective.

The model estimates the relationship between the values of various asset classes (e.g., equities, and real estate) and various government liabilities (e.g., debt and the unfunded pension liabilities). Historical records are sufficiently long to identify trends in annual returns to government assets, but the annual data provides little information on the correlation of returns between individual assets and liabilities. Consequently, volatility has been calculated from different sources than returns, primarily private sector indices (as a proxy).

To reflect the Crown's total portfolio, the model also includes measures of the Crown's "future tax revenue" asset and "future social expenditure" liability. These two stocks are calculated by taking the present value of expected future Crown cashflows under current policy settings. Naturally, these stocks dominate the portfolio (for example, the tax asset is valued at \$800 billion against a published balance sheet of \$62 billion). They are also very sensitive to assumptions (including current policy settings) and the range is \$600 billion to \$1,200 billion.

The model provides a useful assessment of the general properties of the Government's financial portfolio and the impact of changes to the size and composition of that portfolio. (Details of returns, cost and correlation coefficients are set out in the Table in the Appendix.) Characteristics of the Government's balance sheet that can be inferred from the model are:

- the Government's overall financial position is robust to changes in the investment holdings of its financial subsidiaries. This is due to the dominance of taxation and public expenditure in the Government's portfolio and because the government already holds a large, domestically diversified financial portfolio. It is also a reflection of the current low level of the government's debt and projected fiscal surpluses;

- opportunities exist to reduce the overall risk of the Government's portfolio while simultaneously preserving or enhancing investment returns. These investment decisions do not require the Government to trade off lower returns for lower risk (or, similarly, to accept higher risk to achieve higher returns), since the Government's current portfolio is not "optimal"; and
- a marginal increase in exposure to, particularly foreign, equities may act to reduce the total volatility of the Government's net worth over time.

While this approach allows us to identify some of the exposures and inter-relations across the Government's portfolio, it has empirical and methodological shortcomings. For example, much of the data required for a completely mechanistic approach to identifying the optimal Government portfolio is unavailable and therefore needs to be estimated. Existing risk pricing models cannot fully encompass the full range and types of risks faced by the Government — especially the dominant tax asset and social expenditure liability.

Additionally, beyond the marginal risk-return analysis, this framework does not capture other relevant public policy considerations including:

- the appropriate risk preferences of a sovereign;
- the impact on the Government's credit rating of changing debt levels;
- the efficiency of the Government engaging in particular activities;
- the implications for the economy as a whole (e.g., crowding out); and
- intergenerational equity issues.

Treasury is currently addressing the question of where the marginal analysis loses validity. In particular, if Government entities were to reduce their holdings of New Zealand Government bonds in favour of equities, it would be the equivalent of the Government borrowing to invest in equities. From an economy-wide perspective, the Government is adopting a greater role in deciding the allocation of investment in the economy.

However, work such as this offers the prospect of assisting governments make decisions about changes in the shape of their balance sheets over time. For example, in thinking about which liabilities to pay down first or the relative riskiness of particular configurations.

### **Other Policy Objectives for Debt Management**

The previous sections have outlined approaches that have been examined by the NZDMO in thinking about an asset-liability framework for sovereign debt management. It is clear that there are differences in opinion on the theory and some considerable empirical

challenges in this work. It is therefore useful to put the asset-liability framework in a broader context of prudent public debt management.

While objectives for sovereign debt management differ in their detail, they all contain reference to reducing cost and risk. From this starting point it is possible to map out some key principles for prudent debt management. Given the imprecision of the results from asset-liability modeling, there has not been a conflict with these principles.

To reduce refinancing risk, the NZDMO has sought to establish a relatively even maturity profile for term debt across the yield curve. In the case of a strong AA OECD sovereign like New Zealand, refinancing risk is more of a concern about pricing, rather than the prospect of a liquidity crisis. As well as reducing the pressure on markets when the supply of bonds increases unexpectedly, an even maturity profile also provides a sovereign with greater flexibility in an environment of fiscal surpluses. It increases the chance of having sufficient debt maturing with which to use surpluses without needing to repurchase debt or build up assets, which have cost and risk consequences. The NZDMO maintains a profile of maturing term domestic debt of 2 - 3% GDP per annum for the next 5 years, after which spacing increases to just over 10 years.

To improve liquidity in the market and therefore reduce the cost of its borrowing, the NZDMO issues large benchmark bonds in the domestic market. The first benchmark bond was issued in 1988, and there are now 8 nominal benchmark bonds across the curve to 2011.

Like many sovereign debt management agencies the NZDMO is strongly committed to the principles of transparency, neutrality and even-handedness in its activities. We believe that adherence to these principles will lower the Government's borrowing costs in the long-run by reducing price uncertainty and encouraging competitive bidding, and that these gains should outweigh any short-term gains available through opportunistic borrowing in the domestic market. These principles are implemented by:

- publishing an auction calendar for the forthcoming year with the Budget;
- allowing open participation in auctions (subject to bidding limits); and
- not engaging in market intervention.

Many sovereigns are now pursuing policies similar to these. Indeed given the importance of appropriate management of refinancing risk, and the gains from improving liquidity and transparency, these measures should come first. Asset-liability management relates essentially to the management of market risk, and derivatives may be used to achieve desired outcomes. Also, given the caveats that surround the current state of play in sovereign asset-liability management, it would be unwise to follow the results of such work if it cuts across the "easy wins" of sound debt management principles.

## **Use of an Asset/Liability Framework to Improve Management of Risk**

The territory covered so far in this paper focuses on how a sovereign balance sheet may be used to provide information about the appropriate composition of the debt.

An asset-liability management framework involving a comprehensive understanding of the balance sheet also provides scope to improve the management of risk for a sovereign. The objective would be to allow natural hedges to be identified, which may save transactions costs, or reveal large cumulative exposures unacceptable to government which need to be reduced to protect the balance sheet. Apart from the “traditional” risk types normally managed by a sovereign debt management agency (such as currency or credit risks), such an approach could conceivably be extended to risks such as insurance and contingent liabilities.

At the New Zealand Treasury we are very much at the “ideas” stage in contemplating these developments. While we have reasonably good information in accounting terms about the government’s assets and liabilities, much of this is highly aggregated (e.g., through the use of equity accounting conventions) and does not provide much detail about risks in many cases.

In addition, the management of the public sector in New Zealand spans a range of governance structures, from core departments (with close relationships with Ministers) to State-Owned enterprises (which are arms-length and have no guarantee of solvency). An underlying principle in the reform of the public sector over the last ten years has been that relatively decentralised management to improve incentives and flexibility, and ensure accountability at all levels. Therefore, the issue of increased centralisation of risk management needs to be carefully balanced against the potential impact on accountability arrangements.

To illustrate how “broader” risk management can be used to improve overall efficiency, I would like to provide some examples from New Zealand.

One area, which we have implemented, is the government’s financial relationship with the IMF. For the uninitiated this is a relatively complex and arcane subject – and details are not required to illustrate the problem. The bottom line is that membership of the IMF creates both assets and liabilities for governments in the composite SDR currency. Interest is payable and receivable on some portions of these, accordingly to formulae that involve averaging various market rates over certain time periods. The magnitude of these assets and liabilities may change over time, depending on the IMF’s operations.

Within the New Zealand government, five separate areas had a role in managing these flows (two in the central bank and three in the Treasury). While the overall outcome from IMF transactions were pulled together in the consolidated financial statements, no one area had the responsibility for overall risk management. As it happened, part of the position was hedged by one entity because of the impact it had on its balance sheet. This resulted in a sub-optimal position for the Government’s overall balance sheet.

Management of this risk has now been centralised with the NZDMO. Natural hedges between the asset and liability elements are now being utilised, with residual exposures hedged if they grow beyond a certain size. This was modeled using Value-at-Risk analysis, with judgements made about the materiality of the impact on the government's operating balance.

Another example is more of a cautionary tale – where comprehensive, centralised information may have reduced risk. The situation involved bonds issued by a corporate, where the price fell dramatically in a short period of time, following the announcement of negative news. It was at this point that Treasury was informed that three different entities held these bonds in their portfolios. While knowing about the situation before the bad news hit would not have guaranteed any action, it would at least have provided choice.

At the very least, a cumulative picture of credit exposures would assist in forming investment guidelines for individual entities. Using more sophisticated techniques, it may be possible for a central agency to offset excessive cumulative risk positions using credit derivatives. This would have the advantage of preserving the autonomy of individual entities, consistent with their accountability arrangements.

Using an asset-liability management framework in such a manner offers Finance Ministries a potentially powerful tool. It allows them to leverage off the investment made in people and systems for debt management, in order to bring greater consistency to risk management across the Balance Sheet as a whole.

## **Conclusions**

An asset-liability framework is conceptually appealing for sovereign debt management, but difficult to implement in practice. To sum up NZDMO's experience, I would offer the following points:

- it is relatively straight-forward to include all financial assets and liabilities in the framework, i.e., those with well-defined and contractual cash flows. The analysis should therefore concern the configuration of net risk positions;
- the extension of asset-liability management to physical assets and “sovereign instruments” (tax and expenditure) raises a number of practical difficulties, that we are all grappling with. However, over the last ten years valuable insights into the cost and risk relationships between the assets and liabilities have been gained;
- an asset-liability management framework is only one component of prudent debt management. Measures to manage other risks, particularly refinancing, liquidity and operational risks, need to be established. Gains in risk and cost reduction in these areas may be considerable; and

- an asset-liability management framework has potential to contribute to the overall management of risk across a government's balance sheet. Apart from "traditional" risk types, such as currency or credit risks, this could be in areas such as insurance, contingent liabilities and commodity risk.

**Table 1: Government Portfolio including Public Sector Instruments**

	GOVERNMENT ASSETS											GOVERNMENT LIABILITIES						Total	
	Real Estate	Elect	Forest Prod	NZ Equity	Foreign Eq	NZ Bonds	USBond	Japan Bonds	Europe	Std Loans	Tax Revenue	Govt Stock	GSF/NPF	US	Japan	Europe	Social Comm		
Book Value (in millions)																			
1997	4,513	4,330	1,706	805	1,345	2,065	3,610	1,883	3,702	1,847	602,189	20,494	21,400	2,709	1,539	1,177	56,566		
<b>Port. Wt.</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.02	0.02	0.00	0.00	0.00	0.45		
<b>Return</b>																			
Average	0.11	0.15	0.03	0.16	0.13	0.07	0.06	0.02	0.05	- 0.01	0.08	- 0.07	- 0.03	- 0.06	- 0.03	- 0.05	- 0.09	0.0018	
Index Variance	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.0003	
Index Std. Dev.	0.03	0.06	0.09	0.13	0.04	0.03	0.07	0.08	0.08	0.03	0.03	0.03	0.08	0.07	0.08	0.08	0.03	0.0184	
<b>Correlation Coefficients</b>																			
	Real Estate	Elec	Forest Prod	NZ Equity	Foreign Equity	NZ Bonds	USBond	Japan Bonds	German Bonds	Student Loans	Tax Revenue	Govt Stock	GSF	US	Japan		European		
Real Estate	1.00																		
Electricity	-0.17	1.00																	
Forest Products	-0.20	0.22	1.00																
NZ Equity	0.09	0.23	-0.04	1.00															
Foreign Equity	-0.18	0.30	0.19	0.28	1.00														
NZ Bonds	-0.15	0.04	0.21	-0.05	0.33	1.00													
USBonds	-0.12	0.54	0.37	-0.02	0.20	0.12	1.00												
Japan Bonds	-0.23	0.09	0.57	-0.24	-0.14	0.24	0.50	1.00											
Euro Bonds	-0.20	0.28	0.40	-0.27	-0.13	0.18	0.64	0.76	1.00										
Student Loans	0.35	-0.16	0.15	-0.10	-0.33	-0.25	-0.27	-0.13	-0.03	1.00									
Tax Rev	-0.06	0.05	0.10	-0.10	-0.35	0.05	0.20	-0.02	0.17	0.02	1.00								
Govt Stock	0.15	-0.04	-0.21	0.05	-0.33	1.00	-0.12	-0.24	-0.18	0.25	-0.05	1.00							
GSF	-0.14	0.17	0.14	0.17	0.40	0.66	0.22	0.27	0.19	-0.38	-0.09	-0.66	1.00						
US	0.12	-0.54	-0.37	0.02	-0.20	-0.12	-1.00	-0.50	-0.64	0.27	-0.20	0.12	-0.22	1.00					
Japan	0.23	-0.09	-0.57	0.24	0.14	-0.24	-0.50	-1.00	-0.76	0.13	0.02	0.24	-0.27	0.50	1.00				
European	0.20	-0.28	-0.40	0.27	0.13	-0.18	-0.64	-0.76	-1.00	0.03	-0.17	0.18	-0.19	0.64	0.76	1.00			
Social Comm.	0.07	-0.09	-0.17	0.09	-0.25	-0.73	-0.25	-0.31	-0.33	0.44	-0.11	0.73	-0.78	0.25	0.31	0.33	1.00		