

# TREASURY WORKING PAPER

98/4

## An Application of Portfolio Theory to New Zealand's Public Sector.

Jeff Huther

### ABSTRACT

In this paper, modern portfolio measures of performance are applied to the New Zealand central government's assets and liabilities. The results of this analysis show the position of the government's portfolio relative to its individual holdings. Using this analysis, alternative uses of budget surpluses are considered: reducing domestic debt, reducing foreign debt, increasing lending to students, and investing in equities. Greater investment in equities, by the government, stands out as improving the performance of the portfolio (ie lower volatility and greater returns).

*Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the views of the New Zealand Treasury. The Treasury takes no responsibility for any errors or omissions in, or for the correctness of, the information contained in these working papers.*

## I. INTRODUCTION

Applying the standard measurement tools of modern portfolio theory to the public sector raises both methodological issues and empirical difficulties that do not have direct counterparts in analysis of private sector investment. In this paper, these issues and difficulties are addressed in an application of portfolio theory to New Zealand using central government holdings in 1997.

The main methodological questions relate to adding liabilities to an analysis that is often only undertaken for portfolios of assets, appropriately valuing those assets and liabilities that are unique to the public sector, and appropriately treating seasonality in public sector instruments (which is much more prominent than in private sector ones). The empirical difficulties lie in choosing appropriate proxies for public sector holdings that are not subject to frequent, if any, market valuations.

Once the methodological questions and empirical difficulties are addressed the analysis is a straight-forward application of a mean-variance framework. One implication of this analysis is that the overall portfolio is robust to changes in the government's holdings of financial assets or liabilities. In part, this robustness is a result of the dominance of tax revenue and social expenditures but it is also because the government holds a fairly diversified financial portfolio. A second implication is that optimal management of the government's portfolio, maximising returns for a given level of volatility, may require the government to alter its current asset and liability management strategy.

These implications can be attributed to the lack of a strong positive correlation between the performance of the government's financial assets and liabilities and the performance of private sector economic activity in the New Zealand. Without a strong relationship between the economy and financial instruments held by the government, those financial instruments provide the government with a hedge against poor tax collection or high expenditures.

In the next section, financial instruments unique to the public sector are added to the government's balance sheet. In Section III, the methodologies and data sources that have been used to price returns and variances of government instruments are described. In Section IV, the analysis and results are shown and discussed. A brief concluding section outlines the implications drawn.

## II. AN OVERVIEW OF NEW ZEALAND GOVERNMENT FINANCIAL HOLDINGS

The New Zealand government's assets and liabilities are managed on a piecemeal basis with nominal Ministerial oversight. Most of this Crown debt is managed by the New Zealand Debt Management Office or the Reserve Bank while assets tend to be managed by individual Crown entities or Departments. The goal of this paper is to examine the aggregate effects on the government's operating balance of the assets and liabilities of these individual entities. Consequently, a fairly broad view of the government's financial portfolio is taken – included are the assets and liabilities of the largest government entities, the government's direct bond holdings, the equity holdings in state owned enterprises (SOEs), tax revenue and social obligations.

A consolidated view of the Crown's assets and liabilities can be found in the Crown's Financial Statements. These statements include the assets and liabilities held directly by the Crown and indirectly through Crown entities. Because net positions mask the Crown's full financial exposure, the following analysis will use the gross holdings of Crown entities as stated in each entity's annual report. This grossing-up process adds significant value to the Crown's assets through both bond and equity holdings and value to the Crown's liabilities through commitments to pay government pensions and medical payments. The net positions of the SOEs are used because the Crown's financial exposure is, at least nominally, limited to its equity position. The Crown's balance sheet for 1996/97, including its public sector instruments, is shown in Appendix 1. The extensions values of public sector instruments are calculated from the present values of the Crown's ability to tax and its social obligations.

The value of an asset or liability plays two roles in the assessment of portfolio performance: returns are calculated as a percent of value and the portfolio weight of each asset and liability is based on value. The value of the Crown's authority to tax requires calculation since it is not marketable. The value of the taxing authority is taken to be the present value of all future tax revenues. Rather than attempting to estimate how this tax stream will vary with economic activity and political changes, tax revenue has been assumed to be constant and infinite.<sup>1</sup> The resulting calculations are:

Value of Taxing Authority = Tax Revenues (96/97) / Average Borrowing Cost (96/97)

---

<sup>1</sup> Alternative assumptions of future tax revenue and social obligations do not significantly affect the portfolio returns or volatility. This low sensitivity to moderate variations in portfolio weights is because tax revenue and social expenditures dominate the portfolio regardless of revenue and expenditure assumptions.

The average borrowing cost is the average cost of Crown debt across all outstanding maturities (6.8%) less inflation (1.5%). The same approach has been applied to the Crown's social commitments:

$$\text{Value of Social Obligations} = \text{Social Obligations (96/97)} / \text{Average Borrowing Cost (96/97)}^2$$

The Crown's financial assets and liabilities represent roughly 10% of the value of the total assets and the total liabilities. This financial portfolio is diversified across bonds and equities (shown in Table 1) on the asset side and across annuity and bond commitments on the liability side.

**Table 1: Allocations of The Crown's Financial Portfolio**

<u>Financial Assets</u>	
NZ Bonds	15%
NZ Equities	27%
NZ Property	17%
Foreign Bonds	36%
Foreign Equities	5%
<u>Financial Liabilities</u>	
Domestic Borrowing	43%
Foreign Borrowing	11%
Govt Pensions (GSF, NPF)	31%
Medical Payments (ACC)	14%

Ideally, we would use market values of all instruments since the most accessible alternative, book values, are likely to underestimate the contribution of individual assets and liabilities. Some financial instruments, however, have been valued using book values out of necessity. While the Crown's bond holdings and passive equity holding are marked-to-market, the SOE and direct property holdings of the Crown are not publicly traded. This use of book values is likely to underestimate market values due to inflation and, in many cases, asset appreciation. Auckland Airport, for example, had a book value of \$280 million but recently sold for \$390 million. This bias has an effect on both the portfolio weights and the portfolio returns.

The portfolio weights, based on asset or liability value, establish each instrument's contribution to the portfolio return and variance. Consequently those assets and liabilities weighted by book values are likely to be underweighted. In addition, asset and liability values are used to determine returns (capital gains plus dividends divided by value). Consequently, returns to Crown assets and liabilities based on book values are likely to be biased

---

<sup>2</sup> Similar efforts to include long-term social obligations on government balance sheets include Bradbury, Brumby and Skilling (1997) and US Federal Accounting Standards Advisory Board (1998).

upwards. Given a lack of suitable alternatives, these biases have not been addressed.

The book values listed in Appendix 1 are taken from annual reports of Crown entities and the Crown Financial Statements. The portfolio weight of each instrument is that instrument's share of assets or liabilities as of 30 June 1997. These weights are used to determine both the total returns to the Crown and the aggregate volatility of those returns.

Portfolio theory is most frequently applied to analyses of financial assets. The theory is only slightly more complicated to apply when liabilities are included. In constructing the Crown's portfolio, liabilities have been treated as "negative assets" – the liabilities are given negative equity values and interest payments are treated as negative returns. A more sophisticated method, which yields the same results in terms of optimal portfolios, can be found in Elton and Gruber (1992). Elton and Gruber begin by noting that the inclusion of liabilities into a portfolio allows for the possibility of creating a riskless portfolio if asset maturity and returns can be perfectly matched with liability maturity and returns. They then combine this riskless portfolio with residual assets to identify an investor's efficient frontiers. I use the negative asset approach because the illiquidity of Crown assets and liabilities (discussed in Section IV) limits the ability of the Crown to construct a riskless portfolio.

The financial assets and liabilities on the Crown's balance sheet have been combined into 10 types of assets and 5 types of liabilities (the conversion is shown in Appendix 2). This reduction in the types of financial instruments considered greatly simplifies the exposition.

### **III. RETURNS TO, AND VOLATILITY OF, THE CROWN'S ASSETS AND LIABILITIES**

The criteria used to evaluate the performance of the Crown's financial assets and liabilities are the same as used by an individual investor. The textbook goal of a private investor is to maximise the expected return of the portfolio given the investor's tolerance for risk, where risk is measured as the volatility of portfolio returns. This approach, focused solely on the returns and volatility of instruments, ignores the social objectives that may be associated with a financial holding.

Aside from the total value of each asset and liability, two additional measures, based on actual or simulated data, are needed:

- average return, for an asset, or average cost, for a liability
- the volatility of returns for each instrument

Historical records are sufficiently long to identify trends in annual returns to Crown assets, but the annual data provide little information on the correlation of returns between individual assets and liabilities. Consequently, volatility has been calculated from different sources than returns.

#### *Return Calculations*

Average return has been calculated as the annual average return to the Crown based on annual data (sources are listed in Appendix 3). The returns to Crown assets have been calculated by including both dividend or interest payments to the Crown and capital gains as reflected in changes in asset or liability values.

For SOEs, returns have been averaged over the last seven to ten years depending on data availability. For simplicity, the returns to other equity, both foreign and domestic, have been proxied as the average return to equities held by one of the Crown's superannuation funds (the National Provident Fund which passively holds a diversified equity portfolio under management by private investment firms). Returns on other financial instruments, held by Crown-owned entities, are assumed to equal the average annual returns to similar instruments held by the Reserve Bank. Crown liabilities held by other Crown entities have been netted out of this analysis. The financial derivative holdings of Crown entities have been ignored, although realised gains and losses are reflected in returns.

The returns to the Crown's tax authority are proxied in a manner that is meant to mimic returns to a private sector financial instrument for which there is a capital gains component and a dividend component. For capital gains, I have used percentage growth in private sector GDP (natural log differences) which represents the government's revenue base. For dividends, I have used tax revenue as a percentage of the value of the Crown's revenue stream (which, as calculated, is equivalent to the Crown's average cost of capital).

The negative returns of the Crown's social obligations are also proxied with a capital gains component and a dividend component. The capital gains component has been proxied with the population growth rate (again, in log differences) which is meant to capture changes in the underlying potential for increased social obligations. The dividend component is proxied as a percentage of the value of the Crown's liability (which, as with the revenue stream, is equivalent to the Crown's average cost of capital).

### *Volatility Proxies*

Proxies for returns to many of the Crown's financial instruments are needed because they are not publicly traded. The lack of trading means that these instruments are revalued infrequently. Some SOEs, for example, have had a policy of not revaluing their physical assets at all. To estimate intra-year volatility of returns, monthly data from similar private sector instruments have been used as proxies for the volatility of the Crown's financial instruments. Indices are readily available for most types of SOEs and bond holdings (see Appendix 3 for more details on sources).

The volatility of insurance and pension liabilities (through ACC, GSF and NPF) has been proxied by the long term (5 year) domestic bond rate since these liabilities change with changes in long run trends. Ignored are changes in work histories, accident trends and coverage policies may significantly alter the Crown's liabilities associated with these entities. More generally, the future returns to financial instruments may be influenced by a variety of factors, from Asian economic shocks to electrical outages.

The reason for using proxies rather than the raw data on government expenditures is that much of the tax revenue and social obligation volatility is due to multi-faceted seasonality that reflects the statutory nature of the revenue and expenditure streams rather than underlying volatility of the Crown's portfolio. The GDP data was de-trended using a simple least squares regression. The quarterly data series are from the Statistics New Zealand Economic Database.

#### IV. THE GOVERNMENT PORTFOLIO

The returns to individual instruments and the Crown's total portfolio are shown in Figure 1. The volatility of returns (standard deviations) are shown on the x axis and average annual returns are shown on the y axis. The "performance" of a portfolio is said to improve if it moves towards the top left corner of the graph. A portfolio will perform better than its individual instruments if those instruments have negatively correlated returns.

The return to the portfolio ( $R_p$ ) is calculated as:

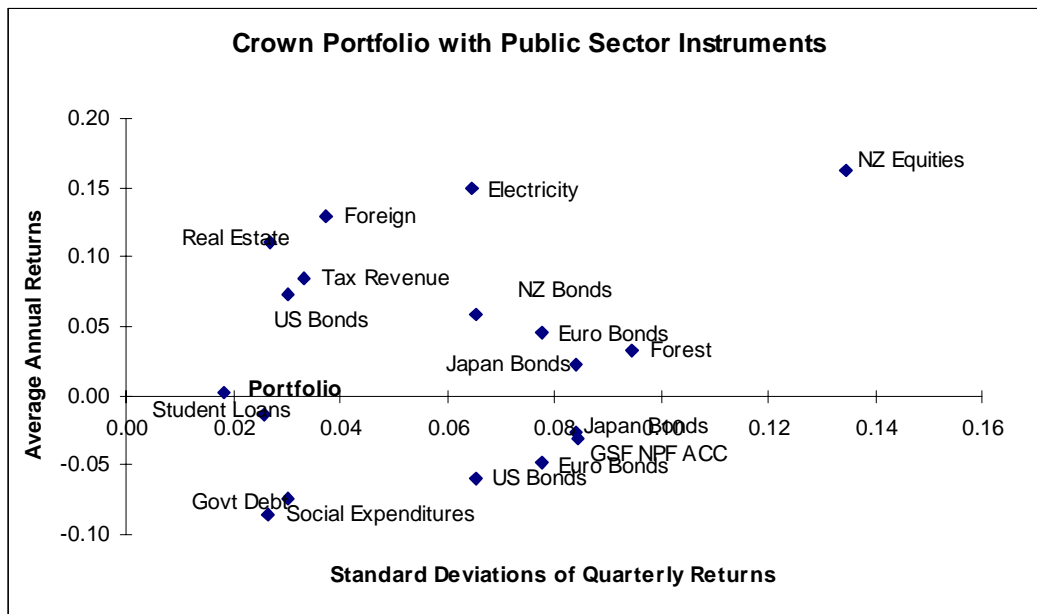
$$R_p = (R_a - R_l) / (A + L)$$

where:

- $R_a$  =  $\Sigma$  Average Asset Returns<sub>i</sub>
- $R_l$  =  $\Sigma$  Average Liability Returns<sub>j</sub>
- A =  $\Sigma$  Asset Values in 1997
- L =  $\Sigma$  Liability Values in 1997

The return to the Crown's portfolio is almost zero (0.18%). This level of return reflects two factors which roughly offset each other – the positive returns from taxes have exceeded expenditures but the cost of financial liabilities exceed the returns to financial assets. Financial liabilities are greater than financial assets because many of the Crown's assets are non-financial (parks, roads, etc) while most of its liabilities are recorded as debt (one notable exception is the liability associated with future payments through New Zealand Superannuation).

**Figure 1**





The measure of volatility is the standard deviation ( $\sigma_p$ ) of the time series of returns:

$$\sigma_p = (\omega' \Omega \omega)^{1/2}$$

where:

$\omega$  = vector of weights (instrument value / sum of assets and liabilities)

$\Omega$  = variance-covariance matrix

The overall volatility of the portfolio, as measured by the standard deviation (1.84%) is low compared to the volatility of many of the individual instruments. As noted above, this low volatility is due to the “natural hedges” that exist in the Crown’s portfolio. These natural hedges are reflected in the correlation coefficients, the relationship between the returns of each pair of instrument, listed in Table 2. In this table, the liability series have been given negative signs so that a negative covariance coefficient between any two instruments indicates a hedge. The correlation of (-1) between foreign bond holdings and foreign liabilities, for example, is an indication of a deliberate policy to reduce the Crown’s exposure to exchange rate volatility.

The returns and volatility of the financial instruments illustrated in Figure 1 and reported in Table 2 are roughly what we would expect – the returns to equities have been, on average, greater than the returns to bonds but these higher returns have been at the cost of greater volatility.

The lack of a high correlation between tax revenue and expenditures may reflect a conflict between efficient management of the Crown’s finances and the demands of society. From the Crown’s point of view, financing costs (and associated risks) would be minimised if expenditures were positively correlated with revenues. From individuals’ perspectives, however, utility would be maximised if expenditures were negatively correlated with revenues. This conflict suggests that volatility in the Crown’s balance sheet may be providing a positive benefit to society by reducing the volatility of individuals’ consumption.

In the absence of any constraints on Crown holdings, the Crown’s investment opportunity set would have included portfolios that include all of the points in Figure 1. In practice, however, the Crown’s flexibility in changing the composition of its portfolio is limited by market constraints, institutional structures and incentive problems. For a discussion of the incentive problems facing public managers of financial portfolios, see “Governance of Crown Savings” by Nick Davis.

**Table 2: Crown Portfolio including Public Sector Instruments**

	CROWN ASSETS												CROWN 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		

The Crown faces market constraints due to the peculiar characteristics of public sector holdings and the Crown's large size in some markets. Assets such as SOEs, for example, may be illiquid or the Crown's position in these types of assets may not easily be increased. In addition, if the Crown were to make large changes in the quantity of debt it holds, it would affect the price of that debt. The costs of issuing debt may vary across countries (issuing debt in Japan, for example, can be higher than issuing debt elsewhere). The Crown may not be able to fully hedge foreign positions due to insufficient commercial transactions between other countries and New Zealand. Consequently, the efficiency of the Crown's portfolio (where efficiency is defined as the maximum return available, given return volatility) cannot be evaluated without fully incorporating all of the constraints faced by the Crown.

### *Alternative Portfolios*

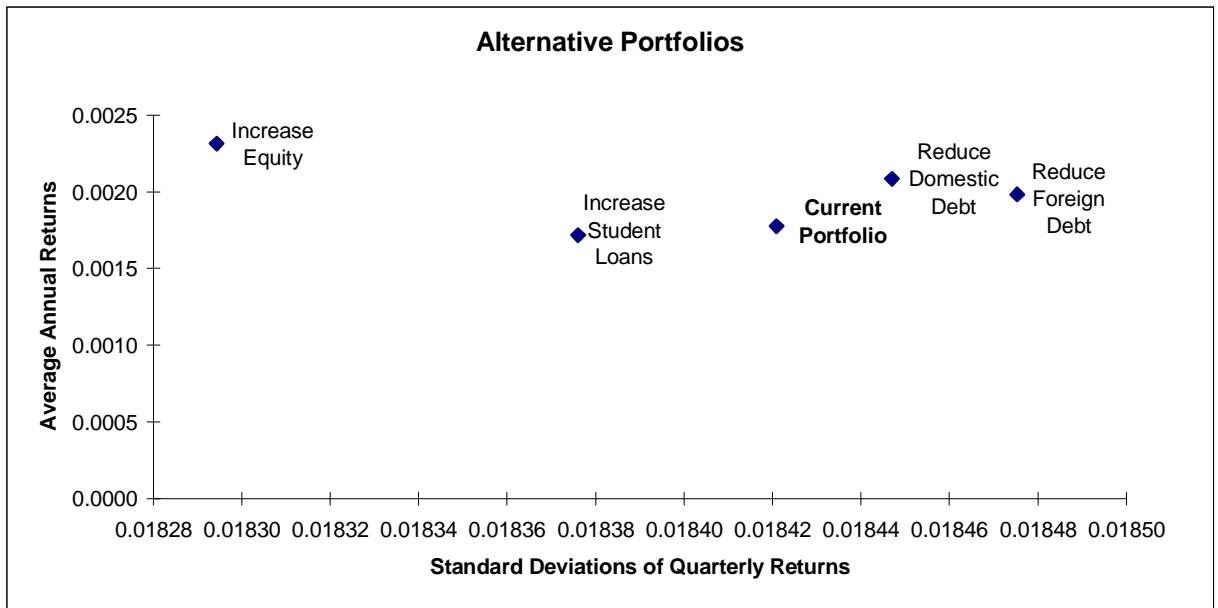
Could the government have held an alternative portfolio that generated a higher return for the same amount of volatility? Or, could it have held a portfolio that generated the same return with a lower level of volatility? To examine potential changes, three examples are considered as illustrations of this approach to portfolio management. The usual caveats apply -- the various changes show what the portfolio performance would have been if the Crown had, for example, sold additional SOEs over past decade (rather than what the portfolio performance is likely to be if it sells SOEs in the future). Also, note that this is a static analysis of the Crown's portfolio. The Crown's current portfolio and alternative portfolios considered are discussed in the absence of any discussion of transitions from one portfolio to another.

Consider the following changes of \$5 billion to the Crown's portfolio:

- Reduce Foreign Debt (\$2 b US, \$2 b Yen, \$1 b DM)
- Reduce Domestic Debt
- Increase Equity (\$4 billion foreign, \$1 billion domestic)
- Increase Student Loans

These alternative portfolios are illustrated in **Figure 2**. Note that the scale in Figure 2 has been reduced so that the changes are more readily identified. The small scale of these potential changes is due to the large weight of taxes and social expenditures and suggests that changes of the scale described, \$5 billion, would have had a marginal effect on the Crown's portfolio. This is not surprising given that total assets, as calculated, exceed \$600 billion. What may be surprising is the direction of the effects of marginal changes in the portfolio.

Figure 2



A striking point in Figure 2 is effect of increased equity holdings. If one views the top of Figure 2 as north, any movement in the portfolio to the northwest would have had an unambiguous benefit – the Crown would have had higher returns with lower volatility. Consequently, Figure 2 shows that the Crown could have benefited from an increase in equity holdings. Similarly, any movement in the portfolio to the southeast unambiguous would have worsened the Crown's portfolio (student loans just barely fall into this category). Figure 2 also illustrates a drawback of paying off debt – portfolio volatility may rise since debt payments are a relatively stable component of the portfolio. Shifting the debt composition from domestic to foreign lenders would have increased volatility over the past ten years.

## V. CONCLUDING COMMENTS

One question underlying this analysis is, does volatility really matter to a sovereign entity? Unlike a private investor, governments can generally be expected to have the reserves or borrowing capacity to weather any periods of low returns. And, given sufficient reserves or borrowing capacity, there may be no reason to realise capital losses. The offsetting argument is that political decisions often reflect present conditions (a process that is not entirely irrational, given the accuracy of economic forecasts). Consequently, poor financial performance in a single period, or over several periods, is likely to have real effects on taxes and expenditures even if we feel reasonably confident that the future will be better than the present.

To the extent that we are seeking marginal improvements in the Crown's portfolio, this analysis raises questions about the strategy of paying down debt. Based on the data available, small increases in equity holdings would both increase the returns from the Crown's portfolio and reduce the volatility of those returns.

It should be stressed that the only criteria applied in this analysis are the expected returns and expected volatility of the Crown's portfolio. Social commitments, among other constraints, are likely to influence portfolio holdings. It can be argued, for example, student loans help the Crown meet objectives other than maximising return for a given level of volatility. This argument, however, does not imply that the Crown must hold student loans – there may be private sector lenders willing to bear some of the risk associated with student lending.

**Appendix 1: Crown Balance Sheet, 30 June 1997, with Tax Revenue and Expenditures (in million NZ \$)**

<b>Assets</b>		<b>Liabilities</b>	
<i>Crown entities</i>	20094	<i>Debt (book value)</i>	35,972
HNZL	3,953	Govt Stock	26,403
GSF	3,348	US Bonds	2,976
NPF	2,874	Other Currencies	1,793
EQC	2,729	Japan Bonds	1,578
*Tertiary ed	2,021	*RB bills	1,236
ACC	1,704	*EQC Deposits	811
*CHes	884	*Loans & FX contracts	672
*Te Papa	758	*Retail Stock	503
*Schools	639	<i>GSF Liabilities</i>	11,676
*Airports	344	<i>ACC Liabilities</i>	6,772
*Other	327	<i>Payables</i>	4,001
*Research	248	*Taxes	1,284
*Fire Service	172	*Accounts	982
*Housing Corp	61	*Accruals	972
*Regional Health	32	*Equicorp	361
<i>Physical Assets</i>	14,502	*Employee entitlements	306
<i>Highways</i>	8,210	*NPF Indemnity	96
<i>Securities</i>	6,988	<i>NPF Liabilities</i>	3,325
US bonds	3,014	<i>Currency</i>	1,741
Japan bonds	1,734	<b>TOTAL</b>	<b>63,487</b>
Other currencies	1,137		
NZ	848		
*IMF	255		
<i>State-Owned Enterprises</i>	5,646	<i>Non-balance sheet liabilities</i>	
ECNZ	2,084		
Trans Power	1,384	<i>Major obligations</i>	563,566
Contact	862	Health care	238,113
Land Corp	412	Education	106,151
TVNZ	254	Social services	100,660
NZ Post	179	Core Govt. Services	31,453
GPS	178	Law and Order	24,170
Solid Energy	116	Defence	17,849
Timberlands	111	Transprt/Communication	16,755
Airways	40	Econ. Services	14,396
*Meteorological Service	11	Primary services	6,623
*VTNZ	7	Culture	5,226
*Terralink	7	Comm development	887
*NZ Railways	1	Other	1,283
<i>*Receivables</i>	5,091		
<i>Advances</i>	2,871	<b>TOTAL</b>	<b>627,053</b>
Student loans	1,884		
*Contact	404		
*Housing Corp	309		
*Residual HMU	146		
*Other	48		
*Forestry loans	36		
*Maori rural lending	28		
*Catchment authorities	11		
*Power Co	3		
*Hotel investments	2		
<i>*Forests</i>	505		
<i>*Inventories</i>	295		
<i>Other Investments</i>	214		
*World Bank	75		
*Asian Development	76		
*Other	63		
<i>*Cash</i>	196		
<i>*Intangibles</i>	20		
<b>Total</b>	<b>64,632</b>	Sources: Crown Financial	
<i>Present Value of Taxes</i>	<b>602,189</b>	Statement 1996/97 and	
<b>TOTAL</b>	<b>666,821</b>	Annual Reports year-end	
		1997	

## Appendix 2: Conversion of Balance Sheet into Portfolio Categories

	Real Estate	Electricity	Forest Prod.	NZ Equity	For Equity	NZ Bonds	US Bonds	Japan Bonds	Other Bonds	Std. Loans	Tax Rev.	Excluded	Netted Out
<i>Crown entities</i>													
HNZL	3,623											330	
GSF	8								971				2,369
NPF	292			238	1,004	1,276							24
EQC						242	404	144	230				1,709
Tertiary Ed												2,021	
CHEs												884	
Te Papa												758	
ACC				125	176	1,078			82				243
Schools												639	
Airports												344	
Other												327	
Research												248	
Fire Service												172	
Housing Corp												61	
Reg. Health												32	
<i>Physical Assets</i>													
<i>Highways</i>													
<i>Securities</i>													
US bonds							3,014						
Japan bonds								1,734					
Other bonds									1,137				
NZ						848							
IMF												255	
<i>S O E s</i>													
ECNZ		2,084											
Trans Power		1,384											
Contact		862											
Land Corp	412												
TVNZ				254									
NZ Post				179									
GPS	178												
Solid Energy				116									
Timberlands			111										
Airways				40									
Meteors				11									
VTNZ				7									
Terralink				7									
NZ Railways				1									

	Real Estate	Electricity	Forest Prod.	NZ Equity	For Equity	NZ Bonds	US Bonds	Japan Bonds	Other Bonds	Std. Loans	Tax Rev.	Excluded	Netted Out
<i>Receivables</i>												5,091	
<i>Advances</i>													
Student loans										1,884			
Contact												404	
Housing Corp												309	
Residual HMU												146	
Other												48	
Forestry loans												36	
Maori lending												28	
Catchments												11	
Power Co												3	
Hotels												2	
<i>Comm. Forests</i>			505										
<i>Inventories</i>													295
<i>Other Invest.</i>													214
<i>Cash</i>													196
<i>Intangibles</i>													20
Value of Taxes											128,742		
Total Resources	4,513	4,330	616	978	1,220	3,444	3,418	1,878	2,420	1,884			



	Govt. Stock	GSF/ NPF	ACC	US	Japan	Europe	Social Comm.	Exclude	Net
<i>Debt (book value)</i>									
Govt. Stock	20,494								7,956
T Bills									
US Bonds				2,976					
Other Bonds						1,793			
Japan Bonds					1,578				
RB bills									1,236
EQC Deposits									811
Loans & FX contracts								672	
Retail Stock								503	
<i>GSF Liabilities</i>		11,676							
<i>ACC Liabilities</i>			6,772						
<i>Payables</i>								4,001	
<i>NPF Liabilities</i>		3,325							
<i>Currency</i>								1,741	
Total									
<i>Non-balance sheet liabilities</i>									
Major obligations									
Health care							194,154		
Education							86,554		
Social services							82,077		
Core Govt. Services							25,646		
Law and Order							19,708		
Defence							14,554		
Transport/Communications							13,662		
Economic Services							11,738		
Primary services							5,400		
Culture							4,262		
Community development							723		
Other							1,046		
Total Obligations							459,523		
Total Resources	20,494	15,001	6,772	2,976	1,578	1,793	523,010	6,917	10,003

### Appendix 3: Methodology and Data Sources (as at 1 September, 1998)

Asset classes have been created by combining similar types of securities. For equities, **ECNZ**, **Trans Power** and **Contact** have been combined into a single electricity equity. **HNZL**, **Government Property Services** and **Land Corp** have been combined into a single property entity. And, **Forestry Corp** and **Timberlands** have been combined into a single forestry equity. All other SOE holdings have been lumped together with domestic equity shares held through Crown-owned entities. For **student loans**, an index has been created based on changes in interest rates, unemployment, weekly wages and emigration rates. This index is meant to capture changes in the loan default rate and interest concession that low income borrowers are entitled to. The **financial assets** held by Crown-owned entities have been separated into asset classes based on country of origin. Data sources are listed below. Data on SOEs and Crown entities are from each entity's annual reports. Most of the index data are from the Bloomberg Information System.

<u>Asset</u>	<u>Mean</u>	<u>Variance</u>
Real Estate	HNZL, GPS, Land Corp.	REI Median house prices
Electricity	ECNZ, Trans Power, Contact	Dow Jones Utilities Index/ (Dow Jones Industrials * NZSE 40 Total Return Index)
Forest	Forestry Corp, Timberlands	Price of Radiata Pine, A- Grade
Other NZ Equity	Airways, Post, TVNZ, Coal, and entity-held equities	New Zealand Stock Exchange Total Return Index
Foreign Equity	Entity-held equities	Morgan Stanley Global Equity Index
NZ Bonds	RBNZ Avg. Return 1994-97	CS First Boston Index
US, German and Japanese Bonds	RBNZ Avg. Return 1994-97	JP Morgan Bond Indices
Student Loans	Returns in 1997	Weighting of changes in earnings, employment and emigration
Tax Authority	Tax / GDP Average	Quarterly Private Sector Consumption Figures, Detrended
<u>Liability</u>	<u>Mean</u>	<u>Variance</u>
Govt Securities GSF/NPF/ACC	RBNZ Avg. Return 1997 Avg. Change in Liability	CS First Boston Index RBNZ Return to 5 yr. Govt. Bonds
US, German and Japanese Bonds	RBNZ Avg. Return 1994-97	JP Morgan Bond Indices
Social Obligations	Expenditure / GDP Avg.	Quarterly Govt Final Exp. Figures

## References

Bradbury, Simon, Jim Brumby and David Skilling (1997). "Sovereign Net Worth: An Analytical Framework." New Zealand Treasury working paper.

Davis, Nicholas (1998). "Governance of Crown Savings." New Zealand Treasury working paper.

Elton, Edwin and Martin Gruber (1992). "Optimal investment strategies with investor liabilities." Journal of Banking and Finance 16 p. 869-890.

Rajan, Raghuram; Henri Servaes and Luigi Zingales. "The Cost of Diversity: The Diversification Discount and Inefficient Investment." NBER, January 1998.

US Federal Accounting Standards Advisory Board (1998). "Accounting for Social Insurance." Exposure Draft, February 20.