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An Integrated Approach to Government Financial Policy

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Abstract

In this paper, I address three questions of government financial policy: how should a government's aversion to financial risk be determined, when are new financial investments justified, and what is the optimal level of reserves in a flexible exchange rate regime. To answer these questions, I modify an integrated financial model developed by Froot and Stein (1998) to describe private sector financial policy. Financial risk aversion in this model is due to the potential of poor financial returns limiting an institution's future investment opportunities. The potential for poor returns provides governments with incentives to hold reserves and limit new financial investments.

While governments typically hold large financial portfolios, theoretical guidance on how governments should manage financial assets and liabilities has generally been limited to reserves necessary to support a fixed exchange rate regime, on the asset side, and the optimal composition of debt, on the liability side.[1] This literature is of little help for a government with a flexible exchange rate and substantial financial liabilities that are not in the form of debt instruments (largely pension and insurance obligations). Basic questions that are often ignored or side-stepped include how to determine the appropriate government aversion to financial risk, when are new financial investments justified, and what is the optimal level of reserves in a flexible exchange rate regime.

At the New Zealand Treasury, we have had extensive debate on the level of financial risk aversion that is appropriate for a government. In general, discussants fall into one of two camps; those who believe that the government's low borrowing costs are due, at least in part, to its conservative management of its financial resources and those who believe that the government's ability to generate revenues, both across the economy and through time, should make the government indifferent to financial risk. The strikingly different implications for financial management highlight the importance of establishing a good theoretical framework.

Sovereign risk aversion is placed in the context of changes to the government's financial portfolio. These changes revolve around proposals to make marginal changes in the composition of the portfolio or to make small changes in the levels of government investment. To put these proposals in stark terms, consider the question: Given the government's ability to borrow cheaply, why doesn't it invest heavily in equities markets where returns are expected to be greater than borrowing costs?

In this paper, I describe some of questions relating to government financial risk aversion, new investment decisions and optimal levels of financial reserves. I place these questions in the context of a recent model on the risk management of financial institutions, Froot and Stein (1998). I then show that this model can be applied to the public sector to provide guidance, at the theoretical level, in choosing a government's optimal level of new financial investment and its optimal level of reserves as well as identifying critical parameters for determining a government's aversion to financial risk. The Froot and Stein model relies on the assumption that borrowing costs rise with borrowing levels. Based on this assumption, governments have incentives to reduce financial risk; incentives which manifest themselves in the forms of holding reserves and diversifying financial investments.[2] I conclude the paper with remarks on the implications of the model for government financial policy.

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[1] By government financial policy, I am referring to the management of marketable assets and liabilities. Throughout the paper, I will maintain a distinction between management of financial instruments, on one hand, and tax and expenditure issues associated with fiscal policy on the other.

[2] In the Froot and Stein model, hedging can also be used to reduce financial risk. I omit this aspect of the model due to the difficulties governments would have in hedging some of their financial positions because of the scale of their holdings.

I. Financial Risk, Investment Decisions and Reserves

Government Aversion to Financial Risk

Public sector risk aversion is a bit paradoxical. To the extent that a government's ability to repay is associated with its financial investments, it can be argued that a government should be highly risk averse in order to maintain favourable borrowing costs. From a practical point of view, this approach is easy to implement – the government invests in financial assets that exhibit the same properties as its liabilities (i.e. other governments' bonds).[3]

By associating a government's ability to repay with its capacity to raise revenue, however, a government's investment policy for financial assets is more difficult to determine. The ability to generate revenues across an entire country and across multiple generations should lead a government to a level of risk aversion approaching risk neutrality – poor returns in any given period, or group of periods, can be absorbed without bankruptcy. Since temporal shocks can be absorbed without bankruptcy, governments could minimise the welfare costs of the financial portfolio by investing in high risk – high return securities. From this point of view, the Froot and Stein model provides a useful approach for narrowing the range of potential levels of government risk aversion by identifying a source of costs to a government of accepting financial risk.

By institutional risk aversion, I mean that the institution's financial managers require increased expected portfolio returns for increased expected portfolio volatility. While this definition of risk aversion is consistent with individuals' risk aversion, it is not necessarily a result of aggregating individual preferences for financial risk. Instead I rely, as Froot and Stein do, on the difference between an institution's internal and external financing costs to create a measure of institutional risk aversion. In this context, institutional risk aversion is a result of borrowing costs, which rise with borrowing levels, reducing the net returns to future investments.

Maximising the expected net returns to future investment leads institutions to hedge financial risk, hold reserves, and take a portfolio approach to new investment decisions. Optimal institutional behaviour in this context represents a trade-off between the holding costs of current reserves and future borrowing costs.

In a public sector context, internal and external financing costs differ when the total costs of current taxation (including deadweight costs) are not the same as the total cost of current borrowing (discounted future taxation with associated borrowing and deadweight costs). That is, internal and external financing costs

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[3] The largest financial holdings of many governments are their own bonds. These holdings, which seem to be financially prudent from the perspective of individual government agencies, may be a costly bookkeeping mechanism from a government-wide perspective and may increase the difficulties governments face in ascertaining their total exposure to financial risk.

are likely to differ if either borrowing costs rise with the level of borrowing or deadweight costs rise with the level of taxation.

If the returns to financial instruments were known, a government would be able to minimise the welfare costs of financing by choosing its levels of taxes and financial reserves so that the marginal costs of current borrowing equal the marginal costs of future borrowing. In the absence of known financial outcomes, a government would be prudent to hold reserves to avoid high borrowing costs when financial returns are below expectations. Financial prudence, however, has a cost in terms of higher current taxation. The question is how risk averse should a government be, given the deadweight costs of taxation.

A government's financial portfolio is defined as its contractual debt obligations and its equity and bond holdings. This definition deliberately excludes the government's taxing authority and its legislative expenditure obligations, including entitlements.[4] To simplify the analysis, I assume that the government's financial portfolio only affects individual utility through taxes. This approach differs from Kaplow (1994) who showed that government financial instruments could be used to offset tax-created distortions in individuals' financial portfolios. In this paper, I assume that changes in the government's portfolio have no effect on the relative prices of financial instruments.

Financial Investment Decisions

Inter-generational equity and fiscal prudence suggest that governments, like the private sector, should acquire financial assets as they generate financial liabilities. Examples of government generated contractual liabilities include employer-sponsored pension plans and government insurance plans. In addition, it may be prudent for the government to hold financial assets for potential liabilities that accrue through the government's role as lender and insurer of last resort.

A government may change the size of its financial portfolio through changes in assets and liabilities or through changes in its level of reserves. Reserves are defined as holdings of other countries' sovereign debt while investments are defined as any other financial instruments. On the liability side, the number of beneficiaries covered by pension or insurance plans may change or the level of benefits may change.[5] Governments may choose to adjust the assets held to meet those liabilities. Reserves may be adjusted because potential liabilities decline (by risk-shedding, say, through privatisation or through risk-mitigation) or because borrowing capacity increases (say through a decline in interest rates or debt reduction).

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[4] In addition, non-performing (in a financial sense) assets, such as schools and roads, are ignored.

[5] To maintain the distinction between financial policy and fiscal policy, the pension obligations I refer to here are those that the government accrues as an employer rather than through social policy.

In the case of a change in investment levels, decisions on asset allocations are often made on an agency level with little or no regard for the government's overall portfolio. This entity-based approach is justifiable if the government's accounting system does not allow for identification of the government's entire portfolio but makes it difficult for decision-makers to assess the government's aggregate financial exposures.

Reserves

Like other government-held assets, I assume that holding reserves creates deadweight costs for society since those reserves could be returned to taxpayers through tax reductions. Alternatively, reserves could be used to pay down for governments with outstanding debt. In practice, the level of reserves in countries with flexible exchange rates may be the sum of the residuals from tax, expenditure and debt policy decisions rather than the result of an explicit weighing of the costs and benefits of holding reserves.

While there are several potential justifications for holding government reserves,[6] most of the theoretical work has focused on a government's support of a fixed exchange rate regime. In the model developed in the following section, I assume that reserves are held to give a government greater flexibility in financing new investment. That is, I limit the following discussion to the use of reserves for investment purposes where the use of reserves is expected to lead to positive returns. I do not consider cases where the use of reserves is expected to generate externalities which may benefit the government. For example, government intervention in illiquid financial markets could be viewed as an investment that will be repaid through increased GDP but not necessarily through the return to the intervention instruments.

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6 Archer (1996) identified six potential reasons for a government to hold reserves: to intervene in foreign exchange markets, as a transaction buffer, as a balance sheet hedge, to maintain a financial "war chest", to improve the financial portfolio of governments with net asset positions, or to improve perceptions of credit-worthiness. To this list, intervention in equity markets, as demonstrated by the Hong Kong government, could be added.

II. An Integrated Approach to Government Portfolio Management

In this section, I show how the model developed by Froot and Stein for private sector financial institutions can be applied to the public sector. After describing how the model works, I modify the mathematics in their paper and reach similar conclusions to Froot and Stein: institutional risk-aversion is justified when borrowing costs rise with borrowing levels, institutions should be concerned with the correlations in returns between instruments, and an institution's pre-cautionary reserves should vary with future investment opportunities.

The main change I make is in the specification of the objective function. A government's financial portfolio is linked to its welfare objectives through its influence on taxes and expenditures. For the purposes of this paper, I assume that the expenditure stream is independent of returns to the government's financial portfolio. That is, deviations in financial returns from expected returns are met with changes in debt levels first. To the extent that these deviations are not reversed in future periods, taxes are adjusted.

In addition, I will assume that volatility of a government's tax stream is undesirable so that government financial management has the following conflicting objectives; to generate returns as high as possible and to minimise the resulting volatility that those returns have on the tax stream.

One possible justification for a government's desire to minimise the volatility of tax returns is Barro (1979), who uses a quadratic deadweight cost function to show that, for a given stream of expenditures, minimising tax volatility maximises individuals' welfare. More generally, to the extent that a less volatile tax stream may imply less volatile consumption streams for individuals, the objective function above is consistent with intertemporal optimisation in Ramsey-type utility functions.

There is a trade-off between modelling the effects of investment decisions on future welfare and tractability. One of the attractive aspects of the Froot and Stein model is that the problem and its solution are defined in a three period model. Solving the objective function above requires the government to explicitly take account of the expected returns from its financial portfolio and the effect returns not meeting expectations.

In the first period, the government chooses its level of reserves. This choice represents a trade-off between the expected benefits that reserves provide in terms of future period investment opportunities and the deadweight costs associated with the taxes that those reserves represent.

In the second period, the government chooses its level of new investment. The returns to this new investment and to the existing portfolio determine the investment opportunity set in the third period. Third period investment opportunities are constrained by the government's resulting wealth from the

second period and the government's borrowing costs which are assumed to be a function of the quantity borrowed.

	First Period	Second Period	Third Period
Decision	Level of Reserves	Level of new investment	Optimal further investment given reserves, borrowing costs, and investment outcomes from second period
Constraints	Deadweight costs of holding reserves, higher future borrowing costs of insufficient reserves	Investment opportunities	Diminishing returns to new investments, increasing borrowing costs
Outcome	Reserves set so that the cost of holding additional reserves is equal to the expected rate of return on third period investment	Level of new investment depends on reserves, investment opportunities, and portfolio composition	Investment opportunities constrained by returns to previous period investment

With this approach, a poor investment outcome in the second period reduces optimal investment in the third period. The government's choice of new investment in the second period is determined based investment opportunities and costs in the third period. Based on the investment decision in the second period, the government then chooses its level of reserves.

While this is a three-period model, the focal point is the decision-making in the second period. The third period is necessary so that the decision-maker faces the costs of a poor second-period investment outcome. The first period, which can be thought of as taking place moments before the second period investment decision, is simply the decision to set aside precautionary reserves against adverse investment outcomes. The model is solved by working backwards. We first determine the optimal level of expected wealth to take into the third period, given investment opportunities and the costs of additional borrowing.

The government's third period investment decision depends on its wealth, W, (the returns to second period investment), its cost of borrowing C(B), and the expected returns to the investment, F(W+B). Borrowing costs are assumed to rise at an increasing rate with the level of borrowing and total expected investment returns are assumed to rise at a decreasing rate with the level of investment.[7] Froot, Scharfstein and Stein (1993) show that, if F is concave and C is convex (as assumed), then the payoff function, P, has the properties $P_w > 0$ and $P_{ww} < 0$. The second order condition implies that the marginal returns to the third period investment are decreasing and that a higher level of wealth leads to a higher optimal level of investment. The second implication is due to the cost difference between using reserves or borrowing – higher levels of

[7] Evidence supporting this characteristic of government borrowing costs can be found in Bayoumi, Goldstein and Woglom (1995) and Caselli, Giovannini and Lane (1998).

wealth allow the government to invest more without increasing the chance that it will need to rely on relatively expensive borrowing. The expected payoff to the government of its third period investment decision is:

$$E[P(W)] = \max F(W+B) - W - B - C(B) \qquad (1)$$

The motivation for holding reserves is to reduce the chance of costly financing in the third period due to poor portfolio returns in the second period. To reduce this risk, the government holds more reserves than if it were risk neutral.

Using a CAPM approach, a private sector investors would value of the financial institution's shares based on expected returns and the covariance of those returns with the rest of the market. In the public sector, there is no equivalent that has the acceptance of a single factor pricing model. To maintain simplicity, and to build on the parallels with financial institution objectives, I take the following approach.

As a starting point, I assume that the government's financial portfolio only affects individuals' welfare through its effect on taxes. Second, I assume that cost of debt repayment plus taxation increase at an increasing rate with both debt and tax levels. With these assumptions, the government's objective function can be written as

$$\text{Max } V = \{ E[P(W)] - \gamma \, \text{cov}[P(W), T] \} / (1 + r) \qquad (2)$$

where V is the value of the government's financial portfolio, T is the average tax rate, γ is a non-priced scale factor, and r is the government's cost of borrowing. In this formulation of the government's financial objective function, portfolio volatility is not inherently undesirable. Rather, the financial portfolio volatility only matters to the extent that it influences tax volatility. Taxes may be lowered (or raised) if financial returns are high enough (or low enough). With this formulation, the government's financial managers have the objective of maximising financial returns subject to a constraint on the correlation of those returns with taxes.[8]

Bohn (1990) uses a representative agent model to show that governments should minimise the covariance between unexpected changes to taxes and the expected rate of return on financial securities. The use of a representative, rational agent and complete markets makes the Bohn model difficult to apply to a government portfolio of instruments with different return and risk characteristics. In the Bohn model, the government has the same objective as the individual so the government cannot create value by holding risky assets. In

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[8] While not the focus of this paper, the objective function in equation (2) would also be consistent with a political economy story in which voters had difficulty distinguishing between poor financial returns as a result of poor market performance and poor returns due to bad financial management. In the private sector context, with shareholders instead of votes, this justification for hedging is explored by DeMarzo and Duffie (1995).

equation (2), I take the other extreme -- changes in the government's portfolio have no direct effect on individuals' financial portfolios.

Total returns are decomposed into two components; average return in excess of a risk-free rate (μ) and a disturbance term (ε). The payoff from the second period investment depends on wealth which consists of returns to the initial portfolio ($\mu_P + \varepsilon_P$), returns to the new investment ($\mu_N + \varepsilon_N$), and reserves from the first period less the one-off deadweight (τ) costs associated with holding those reserves, $R(1 - \tau)$. The portfolio includes both assets and liabilities and the net position is assumed to be zero for simplicity. Government wealth is, therefore,

$$W = (\mu_P + \varepsilon_P) + \alpha(\mu_N + \varepsilon_N) + R(1 - \tau) \qquad (3)$$

where α is the amount of new investment. The first order condition from maximising V gives the optimal level of second period investment as:

$$\alpha^* = [\, \mu_N + H\, \gamma\, \mathrm{cov}(\varepsilon_N, T) + G\, \mathrm{cov}(\varepsilon_N, \varepsilon_P)\,] / G\, \mathrm{var}(\varepsilon_N) \qquad (4)$$

where

$$G \equiv - [\, E(P_{ww}) + E(P_{www})\, \gamma\, \mathrm{cov}(W,T)\,] / [\, E(P_w) - E(P_{ww})\, \gamma\, \mathrm{cov}(W,T)\,],$$
$$H \equiv E(P_w) / [\, E(P_w) - E(P_{ww})\, \gamma\, \mathrm{cov}(W,T)\,]$$

This formulation of optimal investment is slightly more complex than the Froot and Stein measure of new investment because I assume that the government cannot fully hedge the systematic risk between its financial investments and the tax stream [i.e. $\mathrm{cov}(W,T) \neq 0$].[9] Institutional risk aversion is created by the objective of minimising the effects of financial portfolio volatility on the tax stream. To achieve this objective, governments should take account of the covariances of new investment returns with the rest of their financial portfolios. Consequently, the willingness to take on new investments should be a function of expected future investment opportunities and the deadweight cost of taxes, as well as the expected return and variance of the investment.

Under this definition of risk aversion, the government is concerned with financial volatility because low returns to second period investments require additional (relatively high-cost) borrowing and lower optimal levels of third period investment. Since risk aversion is a function of wealth, the government's optimal level of new investment will depend on the scale of investment being considered as well as the correlation of the expected returns of that investment with the rest of the government's portfolio.

The attractiveness of this model is that it helps to provide theoretical underpinnings for several types of government decisions. Currently, government investment decisions have been on an agency-specific basis and,

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[9] In the Froot and Stein model, systematic risk is fully hedged by financial institutions. This results in $H = 1$ and $G = -E(P_{ww})/E(P_w)$.

frequently, relied on rules of thumb. The approach described above is an improvement on the standard cost-benefit approach because it provides an explicit theoretical basis for consideration of portfolio effects of financial investment decisions.

The financial objectives in the public sector, however, are typically based on the perspective of individual public entities. A government's financial instruments may be distributed among the central bank, the central treasury or ministerial treasuries, pension or insurance funds, state-owned enterprises, and other state agencies. The lack of a portfolio-wide approach by governments suggests that they are generating sub-optimal returns. Implementing a portfolio-wide approach, however, is likely to be difficult. Equation (4) requires estimations of expected returns, the weighting factor γ, and the relationships between the returns to existing portfolio and both new investment and taxes.

To find the government's optimal level of reserves in the first period, we maximise government value in the second period given the optimal level of investment:

$$\text{Max } V\{W[\alpha^*(R)], R\} - R$$

which, using the envelop theorem, yields[10]:

$$E(P_w) / (1 + r) = 1 / (1 - \tau) \qquad (5)$$

High reserves increase deadweight costs but they also increase the expected net return to investments. The optimal level of reserves represents a trade-off between the opportunity costs of holding reserves and the additional investment return expected from holding reserves. Reserve levels in equation (5) vary with the deadweight-inclusive cost of taxation. If tax rates fall, the deadweight-inclusive cost of taxation is expected to fall. This model suggests that the optimal level of reserves has fallen as well.[11] More generally, countries with low levels of reserves or limited borrowing capacity cannot rely on the behaviour of countries with more robust finances as investment role models – poorer countries should make smaller and lower risk investments.

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10 In the Froot and Stein model, expected returns are not discounted. I believe this is an omission on their part.

11 In New Zealand dollar terms, Treasury reserves have in fact been falling (from $4.3 billion at the end of 1996 to $2.7 billion in January 1999) but Reserve Bank reserves have increased over this period from $3.8 billion to $4.6 billion.

III. Concluding Remarks

The Froot and Stein model is attractive because it explains the risk aversion of financial institutions – the wide spread use of financial hedges, the diversification of investments, and the holding of significant levels of reserves. Governments carry out many of the same functions as financial institutions, notably providing insurance and pension services. Yet governments have been slower to actively hedge market risk and generally do not view investment decisions and reserve levels from a portfolio perspective.
I believe that this model is an important step in the development of a theoretical framework grounds for integrated financial management. For a government, the practical implications of the model are:

- The government's aversion to financial risk is a function of its entire portfolio, and the investment opportunities associated with that portfolio.
- Investment policy should be based on a set of parameters that will change over time. Consequently, decisions on reserve levels and investments should be reviewed on a regular basis and should reflect expectations of future public investment opportunities.
- Asset allocations and reserve levels of one country do not necessarily provide guidance for other countries.

Government risk aversion in this model does not fall neatly into a category of risk minimisation or risk neutrality. Instead, a government's financial managers must weigh the costs of holding reserves, in terms of the deadweight costs they impose, against the costs of increased borrowing if financial returns be less than expected. This approach does not rule out equity investments by governments but it does suggest that the level of such investments should depend on both the government's borrowing capacity and the likely correlation of equity performance with its tax revenue.

The tight constraints of the model are an indication of the complexity of the problem -- at a minimum, three periods are needed to define the investment decision problem and, even then, we have only described the optimal behaviour for a single period. An improvement would be a model in which the investment decisions overlap so that the government is choosing reserve levels, new investment, and hedging levels in each period.

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