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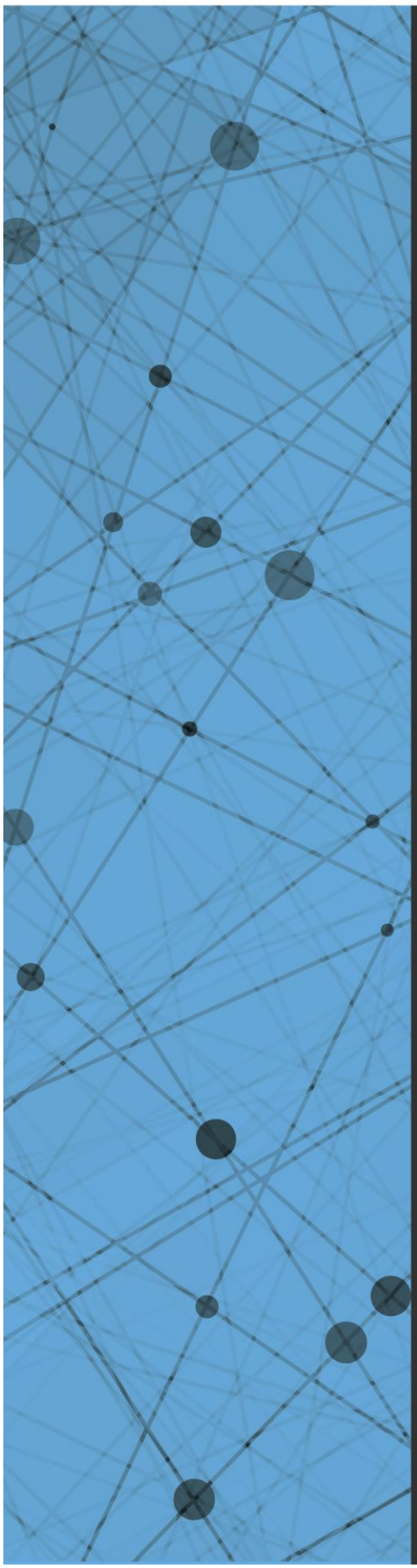

# Liquidity, the government balance sheet, and the public sector discount rate

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**Abstract**

This paper provides a review of the modern finance literature examining how liquidity affects the private sector demand for real assets and financial securities. This literature shows that when firms evaluate risky investments they distinguish fundamental earnings risk and liquidity risks, and choose discount rates that link the discount rates they use to the liquidity and structure of their balance sheets. The government can mimic their behaviour by adopting a procedure that (i) ranks projects by discounting their expected costs and benefits by a low 'fundamental earnings' discount rate, perhaps 4 – 5 percent; and (ii) imposes a second 'liquidity' discount based on the government's balance sheet structure and debt objectives that simultaneously determines the quantity of investments. By more closely copying private sector practice, this approach will directly link the quantity of investments that a government makes to the discount rates it uses. It will also enable the New Zealand government to reduce the discount rates it uses to evaluate long horizon investments without compromising its aim of ensuring the public and private sectors adopt a common method of evaluating investment projects.

**JEL codes**

H43, H54, H60

**Keywords**

public sector discount rate, balance sheet structure, balance sheet liquidity, government investments liquidity

**Summary haiku**

Public investments
should cover borrowing costs,
not risk of default.

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# 1 Introduction

The appropriate way for a government to evaluate and rank policies or investment projects that differ in the size, timing and riskiness of their prospective costs and benefits has long been a contentious subject. Since the costs and benefits that occur at different times or in different states of the world are not equally valuable, they must be discounted to a common basis to allow different projects to be sensibly compared. The choice of discount rate will therefore be crucial in determining which (if any) projects proceed.

The New Zealand Government has traditionally chosen to evaluate investment projects by comparing a project's costs and benefits with alternative private investment opportunities. This approach involves discounting the flow of costs and benefits by the "weighted cost of capital," where the weighted cost of capital is meant to reflect the returns private sector agents demand from different types of investment. The intention is to ensure the same framework is used to assess risk irrespective of whether the project is in the private or public sectors. The approach adopted by the New Zealand Government is based on a standard variant of the Capital Asset Pricing Model (or CAPM) developed by Sharpe (1964) and Lintner (1965) that takes into account taxation. According to this approach, the rate used to discount returns from investment projects should be positively related to the extent that the returns are risky and the extent that this risk is correlated with the riskiness of other assets in the economy. The rationale for this approach has been investigated several times in the last two decades to ensure that the government keeps up to date with the way that the private sector evaluates investments. In general, it has found broad backing within the Treasury (Casey, Heerdegen, and Scobie (2007); Lally (1998); New Zealand Treasury, (2005), (2008); Young (2002)).

This confidence in the existing approach may be misplaced. In the last two decades there has been a transformation in the way economists and corporate finance specialists understand how the private sector evaluates investments in risky assets. The new view has focused on the way that private sector agents distinguish between two different types of risk: fundamental earning risk, the risk that the fundamental earnings of a project may be different than they expected; and 'resale', 'discount', or 'liquidity' risk, the risk that the resale value of an investment may be different than they expect if they need to sell it. This work, which was recognized by the 2012 Nobel prizes awarded to Eugene Fama and Robert Shiller, demonstrates that fundamental earnings risk is not the only factor that private sector agents take into consideration when they make investments or purchase assets.[1] Rather, private sector agents are concerned about the resale value and liquidity of their assets and, conditional on fundamental earnings risk, demand

[1] The Nobel prize committee jointly awarded Eugene Fama and Robert Shiller the Nobel prize in Economics in 2012 for their work investigating the behaviour of financial markets. Their own summaries of this work can be found in Fama (2014) and Shiller (2014).

a higher average return if they invest in assets that are illiquid (Fama and French 1996; Campbell and Vuolteenaho 2004). In addition, private sector firms expend a lot of effort managing their balance sheets to ensure they are not adversely affected by liquidity crises (Shleifer and Vishny 1992; Holmström and Tirole 1998, 2000, 2011). The private sectors' concerns about the resale values of assets varies substantially through time and is one of the reasons why asset prices fluctuate much more than fundamental earnings (Shiller 1981; Campell and Shiller 1989; Shiller 2014.) Interest in this work increased in the last decade as it became recognized that liquidity issues lay at the heart of the 2007-2008 global financial crisis (see, for example, Brunnermeier 2008).

How do private sector firms make these decisions? Obviously practice varies from firm to firm. In most cases, however, there is a two stage process. Firms first discount the expected earnings from a project to estimate the likely investment returns. As a firm has limited ability to borrow, it then decided whether the estimated returns are sufficiently high to justify the additional liquidity pressures that it may face if it undertakes the project – whether it can still raise large amounts of cash in a hurry in response to unfavourable shocks, for example, or whether it can respond to future investment opportunities. Many projects that seem to have favourable earnings potential are vetoed at this stage, essentially suffering a second 'liquidity' discount because the returns are not large enough to warrant the loss of operating flexibility that the firm's balance sheet allows.

The New Zealand Government operates in a similar way. It first evaluates the likely earnings or benefits of a project and estimates the value of the project by discounting these benefits with a high discount rate that reflects average private sector returns. (The recommended real rate was reduced from 8 percent per annum to 7 percent in 2016.) This discount rate is used to rank projects. Government ministers then decide which projects are undertaken, given the government's overall fiscal and balance sheet positions and its debt targets. As projects that have net positive value based on the first criteria are not guaranteed to proceed, this rationing process implicitly imposes a second liquidity discount. This second discount raises average expected rates of return.

While this procedure mimics the procedure used by private sector firms, private sector firms and the government differ in two key respects. First, governments have a comparative advantage at managing liquidity relative to the private sector. This advantage occurs in part because they are indefinitely lived, and in part because their powers to tax future generations enable them to borrow large amounts at low interest rates in a wide variety of circumstances. This means that even if they use the same discount rate to discount fundamental earnings risk as the private sector, they may be able to use a much lower discount rate than the private sector to discount liquidity risks because they are much less suscepitble to liquidity crises. Secondly, governments often invest in highly illiquid assets, including assets such as roads or hospitals

that are unlikely to ever be sold. Just as private sector agents require higher than normal returns to invest in assets that have limited resale value, a government may wish to obtain higher than normal returns from investments in illiquid assets. If so, it would need to use a higher discount rate to value illiquid investments than other investments. Clearly these two factors have opposing implications for the way governments should price liquidity risk.

To date, the literature examining the public sector discount rate has not attempted to distinguish fundamental earnings risks from liquidity risks. Nor has it recognized that the two stage procedure governments use to make investment decisions implictly link their balance sheet objectives to the discount rates they use. This paper represents a first step in this direction. Its aim is to provide a firm conceptual basis for the way that the government should choose a discount rate and make investment decisions. The paper argues that a two stage decision-making procedure is appropriate as it mimics the way the private sector evaluates projects. In the first stage, the government should discount projects using a relatively low fundamental earnings discount rate, perhaps 4- 5 percent real. In the second stage it should add a second discount to reflect liquidity risk, a discount that primarily reflects the government's balance sheet and simultaneously rations the total amount of projects undertaken.

Liquidity issues also affect the way that government should finance their investments. If governments raise the finance for their investments by issuing debt that is to be subsequently repaid by taxes (or the earnings from the project), households receive an extremely liquid security in exchange for their funds. Conversely, if they raise finance by imposing taxes immediately, households receive nothing in exchange. When households have limited ability to borrow, they should prefer government investments to be debt-financed, as these increase their ability to respond to liquidity shocks. Consequently, the returns required by households from a government investment will need to be higher if the investment is tax-financed, just as households will only hold illiquid private sector securities if they receive higher returns.

If the discount rates that the government should depend on the way they are financed, how should these discount rates be calculated? Once again the answer requires the government to simultaneously determine its balance sheet structure with its second stage liquidity discount. If it chooses to finance investments by issuing debt, it should take into account how its higher debt levels can be expected to affect the lifetime utility of households, given the effects of the future taxes needed to be raised to finance the debt, its ability to respond to future shocks on behalf of households, and any effect of the additional debt on the interest rates its pays. If it chooses to finance investments by immediately raising taxes, it should take into account the welfare effects of the taxes and the household's immediate loss of liquidity. When debt levels are low, debt-financing is likely to be welfare enhancing, the liquidity discount the government uses should be smaller, and a higher quantity of projects will be optimal.

The distinction between fundamental earnings risk and liquidity risk, and the links between liquidity risks and the balance sheet structure of the government provide a fresh perspective on the public sector discount literature. As these issues have not been fully explored in the literature examining public sector discount rates, the paper first provides a review of several aspects of the modern macro-finance literature that analyses how private sector agents structure their balance sheets and price different types of risk. This is done in section 2. In section 3, the implications of this literature for the public sector discount rate and the balance sheet structure of the government are discussed. Finally, conclusions are offered in section 4.

# 2 Liquidity, balance sheets, and discount rates: an overview of the literature

## 2.1 Introduction

In a path-breaking paper, Modigliani and Miller (1958) proposed three hypotheses that shaped all subsequent corporate finance theory: that if financial markets are perfect,

1. a firm's capital structure does not affect its average cost of capital;
2. the expected return on a firm's equity is proportional to the amount it is leveraged; and
3. a firm's choice of investments will be independent of the types of securities it issues to finance these investments.

Since then, any papers arguing that a firm's investments or its cost of capital are affected by its financial structure have had to identify an imperfection in financial markets. As this paper argues that a firm's balance sheet and its cost of capital are affected by the liquidity of its assets, this paper begins by explaining why illiquidity is a market imperfection.

According to Holmström and Tirole (2000), firms care about their balance sheet structure because they experience unpredictable and temporary cashflow shortages that need to be managed to ensure the firm continues to exist and operate efficiency. Firms are limited in the extent they can borrow against their future income to help meet these shortages because of asymmetric information issues. The limited ability of firms to issue financial claims against future income, partly because of concern the firm may not exist, and partly to ensure the firms have incentives to perform, is the primary market imperfection. In response, firms carefully consider the liquidity implications of the investments they make and, because different financial claims have different timetables for reimbursing investors, they take particular care about the mixture of financial claims they issue. For example, some firms hold low yielding bank deposits so they can meet unpredicted payments. Other firms pay for lines of credit from banks to ensure they can borrow on demand. Alternatively, firms that make particularly illiquid investments often choose a high degree of equity financing, as the firm will have limited ability to sell assets

in the event of temporary cash-flow demands and dividends are easier to cut than interest payments.

How important are liquidity issues to financial markets, households, and private sector firms? The reassessment undertaken in the last 30 years suggests they are very important. There is now a large body of theoretical and empirical literature that has analysed how the investment decisions of firms and the prices of financial securities are affected by uncertainty about their resale value. This literature can be split into five themes (see Figure 1 for a schematic diagram). The first theme concerns the ways private sector agents value the mixture of debt and equity securities that are issued by firms to finance their investments. The second theme concerns the ways firms evaluate investments in real assets that differ in terms in their expected return, their fundamental earnings risk, and their resale and liquidity risk. The third theme, and the ultimate focus of this paper, is the way governments evaluate investments in real assets. The fourth theme concerns the ways private sector agents value the mixture of debt financing and tax financing that the government uses to finance its investments. The last theme concerns the overall mixture of public and private investments a society makes, given the different returns from their investments and the different liquidity of government and private sector securities.

This section of the paper provides a brief introduction to the parts of these literatures that are relevant to the arguments in section 3. In section 2.2, the links between financial securities' expected returns and liquidity are reviewed. In section 2.3, the ways that firms value investments in illiquid assets are examined. Lastly, in section 2.4 the ways that households' liquidity affects their preferences for debt-financed or tax-financed government investments is analysed.

Unfortunately, there are no universally accepted definitions of the terms 'liquidity', 'illiquidity', or 'discount rate risk'. The phrase "illiquid assets" is used in this paper to refer to assets that cannot be sold quickly without a substantial loss in value, or which have no resale value at all. For example, a corporate bond is considered illiquid if its price is unusually low at times that corporate price-earnings ratios are very low; a factory is illiquid if it is difficult to sell in a hurry; and a road is extremely illiquid because it has very little resale value. In contrast, cash or 90 day government bills are very liquid assets as their value is highly predictable and very close to their face value. The phrase 'discount rate risk' is more difficult to define, but refers to the way the resale value of an asset fluctuates even if its fundamental earnings stream do not change. This topic is sufficiently central to modern finance theory that it provides a good place to begin the section.

## 2.2 Time varying discount rates and the resale value of assets[2]

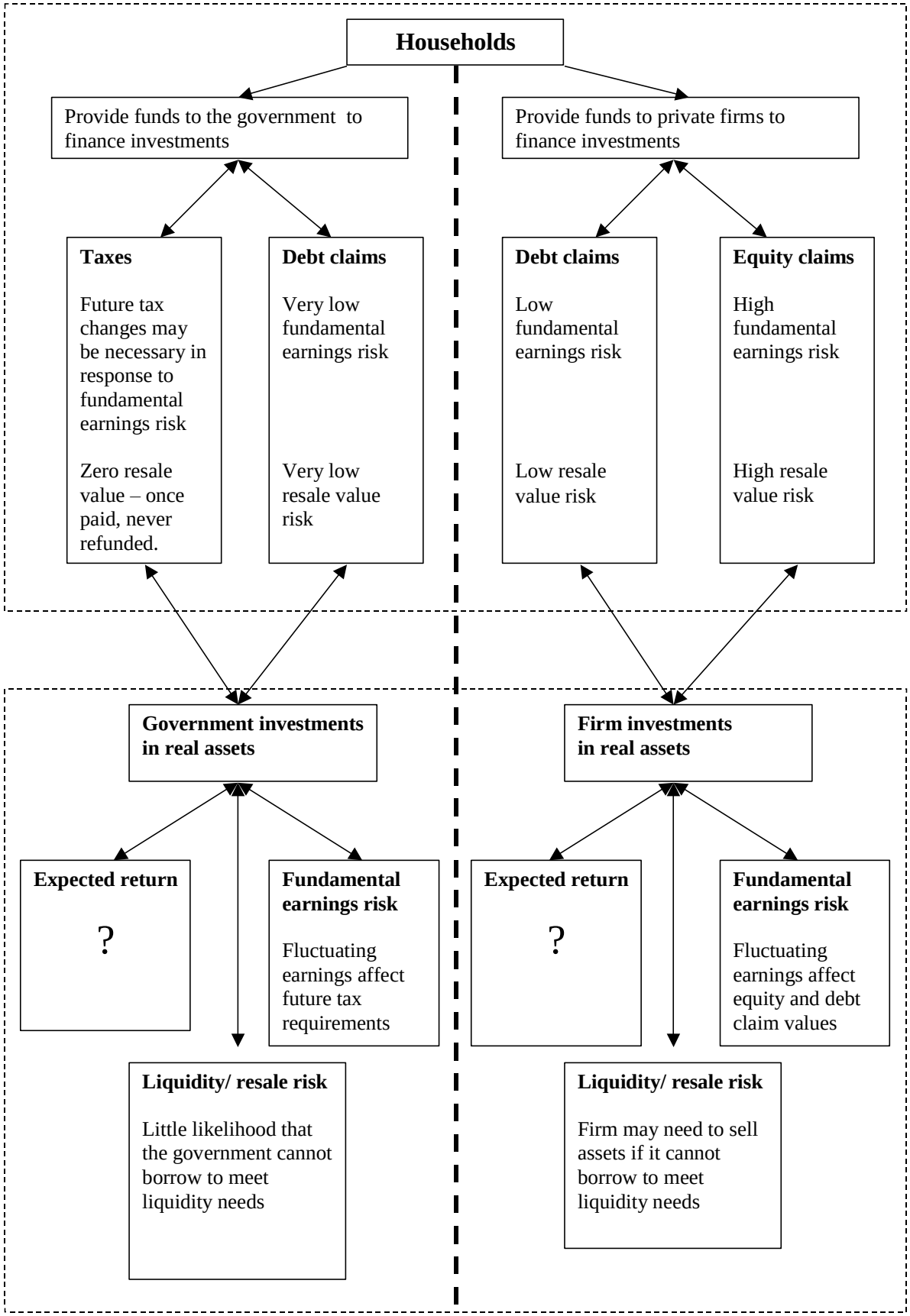
A key idea in financial market theory is that the price of an asset at time *t* will equal the discounted value of the asset's future payment stream. To formalize this notion, Campbell and Shiller (1989) express the gross return from asset *i* between *t* and *t+1,* $R^i_{t+1}$, as

$$R^i_{t+1} = \frac{D^i_{t+1} + P^i_{t+1}}{P^i_t} \qquad (1)$$

where $P^i_t$ is the price of an asset at time *t and* $D^i_{t+1}$ is the value of any dividend or payment made at time t+1. Equation 1 can be rearranged and iterated forward:

[2] This section is based on Cochrane (2007).

Figure 1. Schematic diagram of risks facing firms and the government



$$P_t^i = \frac{D_{t+1}^i}{R_{t+1}^i} + \frac{P_{t+1}^i}{R_{t+1}^i} \qquad (1a)$$

$$= \frac{D_{t+1}^i}{R_{t+1}^i} + \frac{D_{t+2}^i + P_{t+2}^i}{R_{t+1}^i R_{t+2}^i}$$

$$= \sum_{j=1}^{\infty} \frac{D_{t+j}^i}{\Pi_{k=1}^j R_{t+k}^i} \qquad (2)$$

Equations 1a and 2 provide the basis for most theory of how the private sector values assets. Equation 1a states that assets are valued both because of their payment stream and because of their future resale value. Equation 2 states that as the future resale value of an asset depends on subsequent payments, the price of an asset is equal to the sum of discounted future dividend payments, where the discount rate used to discount a payment in period *t+j* is the return on the asset between time *t* and *t+j*. These equations are simple identities. When these equations refer to a comprehensive index of assets, the denominator becomes the average return on assets between time *t* and *t+j*, and the equations state the price of asset equals the discounted valued of their future payment streams, where the discount rate is the average return to assets.

Campbell and Shiller further rearrange equation (2) so that an asset's price-dividend ratio is expressed as a function of the future growth of dividends and future asset returns:[3]

$$p_t^i - d_t^i = \frac{k}{1-\rho} + \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j}^i - \sum_{j=0}^{\infty} \rho^j r_{t+1+j}^i \qquad (3)$$

where

$d_t = \ln(D_t)$;

$p_t = \ln(P_t)$;

$r_t = \ln(R_t)$;

$\rho = e^{\bar{p}-\bar{d}}$ *(the mean price-dividend ratio) and*

$k = -\ln(\rho) - (1-\rho)\ln(1/\rho - 1)$

This relationship is at the heart of Shiller's 1981 empirical work that demonstrated stock prices are excessively volatile compared to their fundamental earnings. If stock prices vary much more than earnings vary, the additional variation must occur because discount rates are varying. For the last thirty years, the literature has tried to discover the factors that drive fluctuations in discount rates. As discussed below, discount rates tend to be high (and asset values low) when

[3] They assume the dividend/price ratio is stationary and take a Taylor expansion around the logarithm of equation 2.

there is an urgent need for money to meet consumption or investment needs, or to meet legal obligations to fulfill contractual obligations. High discount rates at these times suggest that other methods of raising funds, such as borrowing, are not available.

A further rearrangement of equation 4 shows that the difference between actual returns and expected returns is equal to changes in expected future dividends plus changes in expected future discount rates.

$$r^i_{t+1} - E[r^i_{t+1}] = (E_{t+1} - E_t)\left[\sum_{j=0}^{\infty} \rho^j \Delta d^i_{t+1+j}\right] - (E_{t+1} - E_t)\left[\sum_{j=1}^{\infty} \rho^j r^i_{t+1+j}\right] \qquad (4a)$$

$$= \qquad N_{CF,t+1} \qquad - \qquad N_{DR,t+1} \qquad (4b)$$

One implication of this equation is that if returns between t and t+1 are higher than expected, it is either because future dividends are expected to increase, or expected future returns are expected to decrease. This means if asset prices are high relative to current dividends, either dividends will subsequently increase or future returns will be low. A second implication is that, if long run price-dividend ratios are bounded, price changes stemming from changes in discount rates will be subsequently reversed. This suggests that fluctuations in the value of assets that stem that fundamental earnings shocks may be treated quite differently by investors than fluctuations in the value of assets that stem from changes in discount rates.[4]

Equations 3 and 4 have motivated a variety of empirical research to determine the extent that asset price fluctuations are driven by changes in expected earnings and payments, and how much they are driven by fluctuations in discount rates. In theory, high asset prices could predict increasing dividends or low returns. In practice, they generally predict low future returns, but not dividend growth. To someone in the 1970s or 1980s, this would be surprising, as the prevailing view was that high asset prices predict rising dividends.[5] Yet, as Cochrane (1999) and Cochrane (2007, 2011) document, the relationship between price-dividend ratios and future returns is large and robust, in stark contrast to the relationship between price dividend ratios and dividend growth.[6] Aggregate dividend yields typically increase because prices fall; since prices normally recover, future returns increase in a predictable manner. Moreover, price fluctuations stemming from discount rate changes tend to be cyclical, for prices are low and expected returns are predictably high when economic times are bad, when people appear less willing to hold risky assets.

[4] Lettau and Ludvigson (2001, 2004) use this observation to argue that the effect of changes in wealth on consumption depends on the cause of the change in wealth. Changes in wealth stemming from changes in fundamental earnings should have a much larger effect on consumption than those stemming from changes in discount rates as they are long lasting whereas the latter tend to be temporary, albeit still quite persistent. Empirically, in U.S. data most aggregate changes in wealth are transitory and unrelated to consumption.

[5] Of course, individual stocks with high prices tend to pay high dividends, and changes in individual stock prices often predate changes in earnings and dividends. The relationship under investigation concerns aggregate returns through time.

[6] See Koijen and Van Nieuwerburgh (2011) for a critical review of this literature.

Campbell and Vuolteenaho (2004) pushed the dividend growth/ discount rate decomposition further by estimating a CAPM in which the deviation of asset returns from their expected values is split into the two terms in equation 4b. The basic CAPM derives the relationship between the expected returns of a particular asset i and other assets when investors only care about the mean and variance of returns and they can freely borrow or lend at the risk free rate. In these circumstances:

$$E(R^i_{t+1}) = R^f_{t+1} + \beta_{im}\left[E(R^m_{t+1}) - R^f_{t+1}\right]$$
$$\beta_{im} = \frac{\text{cov}(R_i, R_M)}{\sigma^2(R_M)} \qquad (5)$$

where $E[\,]$ is the unconditional expectations operator;

$R^i$ is the one period return on asset *i*;

$R^M$ is the one period return on the market portfolio, the value weighted portfolio of all risky assets;

$R^f$ is the one period return on a riskless asset; and

$\beta_{iM}$ is the beta coefficient , measuring the extent that the asset covaries with the market portfolio.

Campbell and Vuolteenaho derived a variant of the CAPM that splits the return on the market portfolio into the two components $N_{CF,t+1}$ and $N_{DR,t+1}$ that correspond to the dividend growth and discount rate terms respectively. This CAPM has two beta terms and two risk premiums.[7] They argue this distinction is crucial to understanding how private sector agents price risk. It is worthwhile quoting them in full (2004, p1249-1250).

> "The value of the market portfolio may fall because investors receive bad news about future cash flows; but it may also fall because investors increase the discount rate or cost of capital that they apply to these cash flows. In the first case, wealth decreases and investment opportunities are unchanged, while in the second case, wealth decreases but future investment opportunities improve. These two components should have different significance for a risk-averse, long-term investor who holds the market portfolio. Such an investor may demand a higher premium to hold assets that covary with the market's cashflow news than to hold assets that covary with news about the market's discount rates, for poor returns driven by increases in discount rates are partially compensated by improved prospects for future returns. To measure risk for this investor properly, the single beta of the Sharpe- Lintner CAPM should be broken into two different betas: a cash-flow beta and a discount-rate beta. We expect a rational investor who is holding the market portfolio to demand a greater reward for bearing the former type of risk than the latter. In fact, an intertemporal capital asset pricing model (ICAPM) of the sort proposed by Robert Merton (1973) suggests that the price of risk for the discount-rate beta should equal the variance of the market

[7] The cashflow and discount rate betas are $\beta_{i,CF} = \frac{Cov(r^i_t, N_{CF,t})}{Var(r^{eM}_t - E_{t-1}[r^{eM}_t])}$ and $\beta_{i,DR} = \frac{Cov(r^i_t, N_{DR,t})}{Var(r^{eM}_t - E_{t-1}[r^{eM}_t])}$ with $\beta_{iM} = \beta_{i,CF} - \beta_{i,DR}$.

> return, while the price of risk for the cash-flow beta should be γ times greater, where γ is the investor's coefficient of relative risk aversion."

Campbell and Vuolteenaho used U.S. data from 1928 to 2001 to estimate the fraction of the month to month fluctuations in returns that can be attributed to variation in cashflows and how much can be attributed to time-varying discount rates. They showed:

1. most variation in asset prices is driven by shocks to discount rates, not cashflows or fundamental earnings;
2. the covariance between individual asset returns and market returns (the market betas) is dominated by the common movement to discount rate shocks, not cashflow shocks, as the discount rate betas are much higher than the cashflow betas;
3. the price of cashflow risk is much higher than the price of discount rate, as cash flow shocks tend to be permanent whereas discount rate shocks tend to be subsequently reversed.[8]

Although the cashflow risk premium was not precisely estimated in their paper, the difference in the premiums demanded by private sector agents to compensate for cashflow and discount rate risk is considerable. This difference led the authors to describe the two beta as "bad beta" and "good beta." The bad beta is the cashflow risk, for while this only comprises a small part of the overall fluctuation in asset prices, it tends to have permanent effects on asset prices and is thus feared. In contrast, the discount rate beta is good beta, for while discount rate fluctuations comprise the largest component of asset price fluctuations, these fluctuations tend to be temporary, and so have a smaller effect on long run asset prices.

### *2.2.1 The Fama- French three factor model and the value of liquidity.*

Early asset pricing models such as the CAPM contended that agents do not care why asset prices fluctuate but are only concerned about the mean and variance of returns. If this were correct, the only information needed to identify the expected excess returns from an asset would be the asset's beta value (the correlation of an asset's return with the overall market return). All other information would be redundant. This implication has formed the basis of the tests of the CAPM. These tests are typically performed on portfolios of similar assets (for example, portfolios of shares issued by very large companies), as the beta coefficients of these portfolios with respect to the wider market portfolio are estimated with considerably greater accuracy than the beta coefficients of single financial securities. Once the beta coefficients for different portfolios are estimated, the relationships between asset market returns and the estimated betas and other

[8] Campbell and Vuolteenaho solved a multi-period intertemporal CAPM in which asset price changes stemming from discount rate shocks but not cashflow shocks are subsequently reversed. This model captures the persistence of different shocks, and shows the cashflow risk premium should exceed the discount rate risk premium by a factor equal to the agent's relative risk aversion.

factors are examined. The tests depend on the definition of the market portfolio, which typically has been average U.S. equity returns, although often wider classes of assets (including bonds, real estate, and non-U.S. assets) have been used.

Early tests using cross sectional data showed that the CAPM did not provide a complete description of asset market returns. Low beta assets returned more than could be expected from the CAPM theory and high beta assets returned less than could be expected (Fama and French 2004). They also showed that assets with low earnings-price ratios and assets of large stocks typically produced lower returns than could be expected, given their beta coefficients, indicating a premium was paid for this type of security.

Additional research in the 1990s confirmed this analysis. The three factor model estimated by Fama and French (1993, 1996) demonstrated that in addition to an asset's market beta (the variance of returns with the overall market) two factors could explain returns: the size or market value of the company; and the ratio of an asset's book-value to its market-value. Small firms and firms with high book-to-market value have returns that are higher than large firms and firms with low book-to-market value, but these excess returns are unrelated to their market beta. The differences are large. When assets are sorted into 25 portfolios by size and book-to-market value, the small and high book-to-market value firms outperform the large and low book-to-market value firms by approximately 0.7 percent per month (see Table 1). Investors are willing to accept much lower returns from investing in securities issued by very large firms for reasons that have nothing to do with the variance of the returns offered by these securities.

Table 1 :Mean Monthly returns for portfolios sorted by size and Book/Market value (Fama and French 1996: Table 1)

| **Book/Market value→ Size↓** | **Low** | **2** | **3** | **4** | **High** |
|---|---|---|---|---|---|
| **Small** | 0.31 | 0.70 | 0.82 | 0.95 | 1.08 |
| **2** | 0.48 | 0.71 | 0.91 | 0.93 | 1.09 |
| **3** | 0.44 | 0.68 | 0.75 | 0.86 | 1.05 |
| **4** | 0.51 | 0.39 | 0.64 | 0.80 | 1.04 |
| **Large** | 0.37 | 0.39 | 0.36 | 0.58 | 0.71 |

In response to this evidence, researchers have tried to understand why size and book-to-market value are systematically related to returns.[9] The leading explanation is based on the

9 Other researchers have been more sceptical of this evidence, arguing that it does not so much undermine the CAPM as show that researchers have not been able to capture the appropriate market portfolio that investors actually use when valuing assets. This explanation is possible, but a large range of "market" portfolios have now been used in these studies. Few researchers consider this the most likely explanation.

observation that small stocks and stocks with high book-to-market-value do badly at times when the market is particularly distressed. If investors are only prepared to buy stocks that do badly at these times at a price that is sufficiently low that they have high average excess returns, it suggests that investors are particularly concerned about returns in these conditions. This evidence is consistent with the time series evidence that returns are significantly correlated with the state of the economic cycle.

### *2.2.2 Liquidity factors: Acharya and Pedersen (2005)*

The role that liquidity plays in explaining excess returns has been explored by, amongst others, Pástor and Stambaugh (2003) and Acharya and Pedersen (2005). Pástor and Stambaugh demonstrated that the average return to equities that are highly sensitive to overall market liquidity exceeds the average returns to equities that have low sensitivity to overall market liquidity, thereby showing investors demand a high return to invest in illiquid securities. Acharya and Pedersen (2005) developed a theoretical model to explain this phenomena. They derived a liquidity-adjusted CAPM where there are price risks stemming from changes in the liquidity of individual assets and changes in liquidity of the market as a whole. Their theoretical model suggests that investors require a return premium for securities that are illiquid, and an additional premium for securities whose illiquidity increases when the market as a whole is illiquid. Moreover, the model indicates investors should be prepared to accept lower returns for securities that are liquid when the market as a whole is illiquid, or that are liquid when asset prices are low.

Acharya and Pedersen found reasonable empirical support for their liquidity-adjusted capital asset pricing model. They found that equities that had low liquidity on average had high liquidity risk: that is their liquidity was highly correlated with market liquidity overall. The returns to these stocks were sensitive to market liquidity (prices fell when the market became illiquid, reducing current returns but raising future returns), while their illiquidity was sensitive to market returns (liquidity fell when the asset prices fell overall.) When asset portfolios were sorted by size and liquidity, the lowest liquidity portfolio had a large annual return premium of 4.6 percent. This comprised an average premium of 3.5 percent, reflecting the low average liquidity of the stocks, and an additional 1.1 percent that reflected the covariance of these illiquid stocks with overall market liquidity. The most illiquid stocks were small in the sense of having low market value.

This paper, and the subsequent literature, provides evidence that investors are concerned not just about the earnings of securities, but also about the resale value of these assets in market downturns and on occasions when liquidity dries up. As such the model provides further insights into why the additional factors in the Fama-French three factor model matter. Small stocks and value stocks (stocks with low book-to-market value) do particularly badly at times of

market distress, when illiquid assets are difficult to sell, but when there may be a premium for raising funds.

### *2.2.3 Time varying returns and Investment horizons (Lettau and Watcher 2007)*

Lettau and Watcher (2007) provide a suggestive and intuitive link between the Fama-French and the Campbell-Shiller literatures. They developed a model that explained the different returns of growth and value stocks in terms of the timing of their cashflows.[10] Growth stocks are characterised by having a greater proportion of their (discounted) cashflows in the distant future rather than the near future; or, in other words, their cashflows have greater duration, similar to difference between short horizon and long horizon bonds. In turn, they have greater discount rate betas than value stocks, for as their cashflows are further in the future they have greater sensitivity to the way cashflows are discounted. In contrast, value stocks are more sensitive to near term cashflow shocks. Since the price of discount rate risk and the price of cashflow risk are different, a value stock and a growth stock with the same overall beta will have different returns, because their overall beta comprise different mixtures of cashflow and discount rate beta. In particular, since the risk premium associated with discount rate beta is relatively low, the risk premium associated with growth stocks is lower than the premium associated with value stocks. Long horizon stocks may be riskier than short horizon stocks, but investors are more prepared to bear these risks and demand lower premiums.

Lettau and Watcher simulate a model that endogenously derives risk premiums from the duration of earnings associated with different securities. Portfolios created from sorting these stocks by maturity have very similar characteristics to the value and growth portfolios analysed by Fama and French. Their simulated discount rates declined sharply with horizon, from 18 percent per annum for dividends two years into the future to 4 percent per annum for dividends 40 years distant[11]. The different valuation of different horizon cashflows suggests that discounting cashflows with constant exponential discount rates is not the only way, or even the most appropriate way, to value assets.

### *2.2.4 Asset value, liquidity and time varying discount rates*

Where does this leave us? A key result from the recent macrofinance literature is that liquidity is an important determinant of an asset's value. Private sector agents do not just value assets according to the extent that their fundamental earnings are volatile, but also according to the extent they are subject to discount rate, resale value, or liquidity shocks. Private sector agents

[10] Value stocks have high book-to-market value: that is, their share market value is relatively close to the underlying value of their assets. Growth stocks have a market value that is much higher than the costs of their assets.
[11] They note that the sharpness of this decline depends on the correlation between dividends and the unobserved price of risk. They assume this correlation is zero, based on its correlation with the three macroeconomic series that modern theory suggests are linked to aggregate risk aversion: the consumption/wealth ratio, the size of non-housing consumption in total consumption, and the difference between measures of human wealth and outstanding home mortgages. For an extended discussion of the link between these macroeconomic variables and risk aversion, see Cochrane (2007).

are prepared to accept lower returns for assets that are highly liquid. Conversely, private sector investors will only invest in illiquid assets if they earn higher returns - and the returns they need are particularly high for assets whose illiquidity increases at times when the market overall tends to be illiquid.

## 2.3 Firm investments in real assets

By demonstrating that agents demand higher returns to hold illiquid financial securities, the above literature gives rise to an additional question: do firms require higher returns to hold real assets that are difficult to sell? This question is the subject of a second, smaller, literature investigating how the liquidity of real assets affects firms' investment decisions. The conclusion of this literature is that asset liquidity is a central component of the criteria firms use to choose their investments and balance sheets structures.

### *2.3.1 Liquidity and balance sheet structure*

A natural starting point for this literature is a series of papers by Holmström and Tirole (1996, 2000, 2001, 2011). They argued that firms' demands for cash vary significantly and unexpectedly through time, either because of uncertain expenses related to their investment demands or because of fluctuating expenses and sales. Firms structure their balance sheets so they can meet these fluctuating demands without damaging their long term prospects. In response to large temporary cashflow demands they have several options: they can borrow or issue new securities; they can reduce the dividends paid to the owners of equity claims; or they can temporarily sell assets. In a world without financial frictions, the easiest route would be to issue new debt or equity claims. These options are frequently not available in the real world, however, as firms are limited in the amount they can issue securities against future income streams, particularly if their liquidity needs are due to a temporary decline in sales. Given these constraints, firms may have to reduce their expenses to raise funds, or temporarily sell assets.

Assets differ in terms of the ease they can be sold at reasonable prices. Some firms have assets that can easily be bought and sold, typically assets that can be used by many different users. These firms often sell them to raise funds. In most cases, however, there is a limited market for industry-specific real assets, and firms will be reluctant to sell them due to the low prices that can be obtained (Shleifer and Visny 1992; Ramey and Shapiro 2001). For this reason, firms may wish to hold some highly liquid assets such as government or corporate bills to sell in the event that they have high liquidity needs. Moreover, if firms do hold assets that are difficult to sell, they may want to issue more equity claims and fewer debt claims, as the former provide the firm with much greater flexibility in terms of their ability to curtail payments.

This analysis suggests that the returns that firms expect from holding particular assets, and the overall structure of their balance sheets, will depend on the liquidity of these assets. Firms investing in assets that are difficult to sell may issue less debt, hold larger reserves of

liquid assets, and require higher expected returns than firms investing in liquid assets. While this topic has not been heavily researched, there is some evidence to support each of these claims.[12] For example, Almeida, Campello, and Weisbach (2004) show that financially constrained manufacturing firms hold more liquid balances than non-constrained firms, and increase them during recessions when the needs and opportunities for cash are at their highest. Bates, Kahle, and Stulz (2009) document the significant increase in cash holdings by U.S. industrial firms between 1980 and 2006 and argue it reflects a precautionary demand in the face of an increase in idiosyncratic risk and more firm specific investments in (illiquid) intellectual property rather than traditional assets. Almeida and Campello (2007) classify firms by the extent their assets can be resold ('are tangible') and show firms with less tangible assets are constrained in the amount they can borrow and invest relative to those with more tangible assets. Benmelech (2009) used particularly well identified data from nineteenth- century railroad companies to demonstrate that firms with more liquid assets could issue longer maturity debt than those with less liquid assets. Lastly, and one of the few papers directly linking asset liquidity to the cost of capital, Ortiz-Molina and Phillips (2014) examined how a firm's implicit cost of capital depends on the illiquidity of its real investments and showed a one standard deviation increase in an asset's illiquidity increased a firm's cost of capital by 0.9 – 1.4 percentage points.

The evidence from these papers is consistent with the theoretical models that argue firms adjust their balance sheets to reduce debt and increase equity if they invest in illiquid assets, and demand higher returns from such assets. This evidence is also consistent with the much larger literature that shows households demand higher returns from investments in illiquid financial securities. Unfortunately, however, the literature providing detailed quantitative evidence on the size of the premium firms require to invest in assets that are risky and illiquid is still quite thin.

### *2.3.2 Investments in non-marketable assets.*

There are sizeable theoretical and empirical literatures examining the valuation of assets that cannot be sold during particular periods. The first theoretical papers used the CAPM to examine the pricing of assets that paid dividends but which could not be sold (Mayer 1973, 1976). Mayer pioneered the technique of analysing non-marketable assets by making a hypothetical comparison with marketable assets that had identical earnings streams. He demonstrated that there were many circumstances in which people would only hold non-marketable assets if they were priced less than marketable assets, and that in these circumstances the demand for marketable assets would increase.

[12] Damodaran (2005) provides an early assessment of the literature.

This approach was refined in a series of papers by Longstaff (1995, 2009, 2014). He analysed the value of assets that could not be sold during a 'blackout' period, such as shares that could not be sold for five years. He calculated their values by comparing them with the values of hypothetical assets that had identical cashflows but which could be sold at any time. The difference between the two is the value of a put option that allows the owner to sell the asset as well as receive dividends. This means the value of a non-marketable asset can be calculated by a two part process: first, the asset's cashflows are discounted using a discount rate appropriate for discounting a liquid asset; and secondly, the value of the put option is subtracted. Longstaff (1995, 2014) calculated how the value of the option depended on the non-marketability period. The value of the option was very high for short non-marketable periods, but increased only slowly as the horizon increased. For example, Longstaff (2014) shows that the option discount for an asset with 30% earnings volatility is 12% at a 1 year horizon, but only 5% per annum at 10 years and 3% per annum at 30 years.[13]

The discount rates firms use to evaluate investments can be represented as a function $\rho(\tau)$ where $\tau$ is the horizon of the investment. The discount rate function is described as a constant exponential discount function if $\rho(\tau)=\rho^{\tau}$. A key feature of this approach is that discount functions for non-marketable assets increases with the option horizon at less than an exponential rate: that is $\rho(\tau) > \rho(1)^{\tau}$ if $\tau > 1$. This means the combined discount cannot be represented by constant exponential rates. If an investor approximates the two-stage process with an exponential discount rate that simply adds an illiquidity premium to the fundamental earnings discount, the illiquidity premium needs to decline with the length of the horizon.

Ang, Papanikolaou and Westerfield (2014) also use an option pricing approach to value assets with non-marketable periods, but allow the length of the periods to be random. They show that assets that cannot be sold for random periods of time trade at much steeper discounts than assets whose non-marketable period is known with certainty. This is because agents holding these assets are forced to hold larger quantities of liquid assets to compensate for the risk that the asset cannot be sold when they want.

While these discounts appear high, they are supported by a variety of evidence. For example, Amihudand and Mendelson (1991) show that "letter" stocks – stocks that are issued when a firm is taken over that cannot be sold for two year period – routinely trade at a 35% discount to the ordinary, liquid stock. Damodaran (2005) and Longstaff (2009) provide an extensive array of similar examples. These numbers are broadly consistent with the option pricing calculations of Longstaff (1995), Ang, Papanikolaou and Westerfield (2014) and others.

This empirical evidence is based on examples where there were two assets that differed in terms in their marketability actually existed. In most cases, however, the value of an illiquid

[13] The discounts are substantially lower if the asset has regular albeit uncertain earnings streams during the non-marketable horizon, as these earnings help the firm with its overall liquidity.

asset must be calculated hypothetically, and as non-marketable assets are not bought and sold, the option values cannot be calculated from historical price series. In these cases the value of the put option will reflect the firm's potential liquidity needs, its ability to borrow, and the other assets it holds to meet these needs. In short, it will depend on the balance sheet of the firm as well as the underlying earnings streams of the non-marketable asset. These calculations are not easy to make. Nonetheless, general principles indicate that the value of these put options will be increasing in the extent that firms are exposed to illiquidity shocks, but decreasing in the liquidity of the rest of the balance sheet. For this reason, the premium required by a firm to hold a non-marketable asset will be lower for firms with diversified portfolios of liquid and illiquid assets than for firms whose investments are all illiquid.

## 2.4 Liquidity and society-wide portfolio choice

When households are limited in the amount they can borrow against future income, they will demand liquid assets even if they have low returns because they experience shocks that mean they occasionally have large demands for cash. Bencivenga and Smith (1991) and Levine (1991) examine the ways financial markets allow society to increase the fraction of wealth held in high yielding illiquid assets without sacrificing the liquidity demands of households. By issuing debt securities through banks (Becivenga and Smith) or equities (Levine) financial markets allow agents to make investments in illiquid assets while still allowing them to meet unexpected demands for cash, as they can sell their securities when they have unforeseen liquidity demands. These financial securities enable agents to undertake investments in high yielding illiquid assets they otherwise would have avoided. In equilibrium, the members of a society will hold a mixture of low yielding but liquid assets and high yielding but illiquid assets, with the mix depending on relative returns and the likelihood that agents face liquidity shocks.

Will the private sector be able to issue the appropriate mix of illiquid and liquid assets? Woodford (1990) argued that as the private sector will typically not allow households to borrow against the full value of their future income, it will not be able to meet their liquidity needs. In these circumstances the government can raise welfare by financing some of its expenditure by borrowing, as the debt securities it issues enable households to meet random liquidity shocks. Woodford examined the case where the government chooses the timing of taxes to pay for ordinary government expenditure. He showed that when households are limited in the amount they can borrow against future income, they will prefer the government to finance expenditure by issuing debt that is later repaid by taxes. His argument is most easily seen by example. Suppose a government wishes to raise $1000 over two years. It could levy $500 taxes each year. Alternately, it could exchange $500 for a $500 one year government bond in the first year, and levy $1000 taxes in the second year. In both cases it receives a net transfer from households of $500 per year. In the first case, however, the first year payment is recorded as a non-refundable

tax payment, whereas in the second case the households are issued with a bond that they can sell if they have urgent liquidity needs such as medical emergencies or urgent repair bills. If households are limited in the extent that they can borrow against second year income, they are significantly more liquid if their first year transfer to the government is recorded as a loan to the Government (with the promise of higher taxes in subsequent years) than if it is recorded as a tax payment. Woodford argued this additional liquidity will be valuable whenever households are restricted in the amount they can borrow against future income. In these conditions, households are much better off financing a fraction of government expenditure by lending to the Government, even if the loans they make are subsequently forwarded to the government as tax payments.[14]

Woodford's model is solved in a context where the government chooses to finance a stream of current expenditures, not capital expenditures, out of tax. However, the basic insight applies to the financing of investment projects. Households that are credit constrained will prefer the government to finance its investments by issuing debt securities repaid from later taxes rather than by collecting all of the tax at the start of the period, as this provides them with a highly liquid asset that better enables them to manage their finances. Moreover, if they can finance a government investment by lending the government the money, they will be willing to accept a lower expected return from the investment than if they financed it by paying taxes in advance, as they are issued an extremely liquid financial claim in return for their money.

Woodford argues that financing matters because households are credit constrained, just as Holmström and Tirole argue that financing matters because firms are limited in the amount they can borrow. However, the nature of the solution is different. By funding expenditure through debt rather than taxes, the government effectively relaxes the credit constraints on households by borrowing on their behalf. Credit constrained households experiencing liquidity shocks gain from this arrangement, for rather than using their cash to pay taxes or purchase bonds, they can use it for other purposes. Governments can improve the welfare of their citizens by financing their investments with debt because they have a comparative advantage at borrowing relative to households. Their longevity and ability to raise taxes means they can borrow in a wide range of circumstances at interest rates not available to private households.

This liquidity argument provides a third reason why governments may wish to finance long term investments with debt. Normally it is argued that debt financing allows tax smoothing and reduces the intergenerational transfers that would occur if the government paid for a long lasting asset by raising taxes at the start of a project. If the government uses debt to finance a project, repaying the interest on the loan by levying taxes in subsequent years, sudden changes

[14] Note that if liquidity is important to private sector households, Ricardian equivalence does not hold. If households face binding credit constraints, they will not save the whole amount of a temporary debt financed tax reduction; rather they will be content to increase their spending out of current after tax income, and pay higher taxes in a subsequent period.

in tax rates are avoided and taxes are smoothed over time, reducing the distortionary effects associated with high and variable tax rates. Moreover, when long term projects are funded by debt the project can be funded on an intergenerationally neutral basis by making the people benefiting from the project repay the loan.

If governments can raise a society's welfare by financing investments with debt rather than taxes, are there guidelines about the amount a government should borrow? This question proves central to any discussion about the extent that a government should issue low yielding debt securities to finance investments in high yielding assets. When assessing whether an investment is worthwhile, the government needs to calculate the costs of issuing the debt, which include the deadweight costs of any taxes needed to repay the loan and the 'real option' costs that occur because future governments may have fewer options to borrow.

The deadweight costs associated with taxation are now well understood. As Musgrave (1939) first pointed out, this means it is necessary to distinguish between investments in 'self-liquidating' assets such as electricity dams that are expected to produce a cash return capable of repaying the loan and investments in assets that provide non-monetary benefits such as roads or playgrounds that are ultimately financed from tax receipts. For a given cost, assets providing non-monetary benefits need to generate higher returns than assets producing monetary benefits because of the deadweight costs associated with the taxes needed to repay the loans.

It is not straightforward to calculate the 'option' costs associated with issuing debt. These costs arise because when a government issues debt it alters the cost of issuing debt in the future. If the interest rate governments pay on debt are increasing in the amount of debt they issue, or if governments ultimately face borrowing constraints because creditors do not believe they will repay their debts (in real terms) once too much debt is issued, debt that is issued to finance investments reduces the available "fiscal space" that allows governments to cheaply issue debt in the future (Ostrey et al 2010). In principle the value of this real option can be calculated using the procedures used to solve dynamic optimization problems under uncertainty pioneered by Arrow and Fisher (1974) and subsequently refined by a multitude of authors. In practice, however, the problem is sufficiently difficult that precise guidelines for governments are yet to be established.

The key factors determining the real option value associated with any level of debt are the types of shocks that affect government expenditure and revenue patterns, the interest rates the government might have to pay on future debt issues, and the distortionary effects of the taxes levied to repay the debts. The shocks not only include any unexpected costs associated with the particular project, but any shocks that cause debt levels to increase such as the failure of a different project, economic recessions and financial crises, or disasters and wars. The cost of these shocks depends on the extent that the interest rate premium increases with debt levels, and whether some potentially useful policy options are ruled out because the government can

no longer borrow. When there is no debt-related interest rate premium, the real option value largely depends on the way the deadweight costs of taxation increase as debt servicing costs increase.

How much does the level of government debt raise the interest rates governments face? While several recent papers have tried to measure this premium, its value is uncertain. Indeed, the literature is not entirely clear whether the premium depends on the current or future values of the government deficit, or the current or future values of the stock of government debt (Feldstein 1986). Even if the interest rate premium is primarily determined by the debt/GDP ratio, the extent that the relationship is non linear is not clear either. Ostry et al (2010) argue that the relationship is non-linear, with a negligible premium until a high debt/GDP ratio is reached, at which point it increases steeply.[15] In contrast, Laubach (2009) showed there was a strong relationship between forecasts of US debt and deficit levels and US forward interest rates. He estimated a 1 percentage point increase in the government deficit increased interest rate premiums by 30 basis points, while a 1 percentage point increase in the debt/GDP ratio increases 5 year government stock rates by 3 - 5 basis points. Premiums this high would make government debt levels in excess of 75 percent of GDP very expensive, and make it desirable for governments to limit the amount of debt they issue in ordinary times for fear that future adverse shocks would make future debt levels hard to manage.[16]

Why is it important to maintain an ability to borrow? Musgrave (1939) argues it is because current technologies may become obsolescent and a government may need to undertake costly investments in new technologies even while repaying debts on old-technology investments. More recently, it has been emphasized that Governments can experience large increases in debt when they experience wars and economic disasters (Reinhart, Reinhart, and Rogoff 2012). These disasters place governments under considerable financial pressure, although the consequences for private sector entities are considerably worse. Indeed, recent literature has shown that the ability of governments to borrow at lower rates than the private sector may stem from how they fare during steep economic downturns and other disasters.

So where does this discussion leave us? Just as the value of private sector firms depends on the way they finance their investments, the value to households of the government's investments depends on how they are financed. When a government issues debt to finance

[15] Using a panel of European data, Baum, Checherita-Westphal and Rother (2012) estimate a threshold relationship; there is a near zero relationship between the debt/GDP level and interest rate premiums if government debt levels are less than 75 percent of GDP, but beyond these levels the interest rate premium increases sharply with the debt/GDP ratio. Reinhart, Reinhart and Rogoff (2012) examine 26 episodes of countries that had debt levels in excess of 90% of GDP, finding that 15 of them had higher interest rates than when they had lower debt/GDP ratios, while 11 had similar or lower levels. They conclude that there is a tendency for interest rate premiums to increase with high debt levels, but an increase is not inevitable, particularly if a country has a reputation for repaying debt.

[16] Baldacci and Kumar (2010) report similar estimates. Yet both of these estimates are higher than those reported in many other studies and sit uncomfortably with current circumstances in which many countries have debt/GDP ratios in excess of 75 percent of GDP yet can borrow at interest rates that are at century-low levels.

projects, it reduces the distortionary effects of taxes by allowing tax smoothing, it enables the project to be intergenerationally neutral, and it enhances the liquidity position of credit-constrained households. This suggests the returns required by households to justify an investment project will be lower if the project is debt financed rather than tax financed. The returns should also be lower for projects that produce monetary returns rather than non-monetary returns, as the former do not entail the distortionary consequences of the taxes imposed to finance them. However, the costs of issuing debt securities to finance investments are not straightforward to calculate. They are related to the real option value of allowing future governments to borrow should the need arise.

### *2.4.1 Economic Disasters*

Beginning with Rietz (1988), a series of papers has argued that the high average returns from investments in risky assets such as equities, and low average returns from investments in government bonds, are best understood as a response to infrequent economic disasters ( for example, Barro 2006, Gabaix 2012, and Wachter 2013). Barro (2006) documented the number of economic disasters (declines in output of at least 15 percent) that occurred in a collection of OECD, South American, and Asian countries in the last 150 years, and showed they were sufficiently frequent in the twentieth century that they provide a plausible explanation for the high returns investors require from equities relative to government bonds. These disasters were associated with major wars or with financial collapses and economic depressions. During financial disasters, equities lost more than 15% per year in real terms, whereas government bills increased in value; during military disasters, equities lost a similar amount of value, but in some of these cases government bills also lost value, either because the government was eliminated by military action or because of subsequent inflation. In short, most disasters tend to have adverse effects on the value of equities, whereas only a fraction of war-related disasters adversely affect the value of government bills.

Barro argued that this pattern of returns can explain the large average return to equities. Investors demand high returns from equities because there is some chance that these assets will fail to provide investors resources precisely at the times they most need them. In contrast, while government bills can do badly during wars, they do relatively well during economic disasters and for this reason investors are willing to hold them even if they return little on average. Seen in this light, Government bills provide insurance and are held despite returning much less on average than private securities.

Gabaix (2012) and Wachter (2013) provide a more sophisticated take on this theme, arguing that the probability of disasters varies over time. This provides one explanation for why equity returns vary so much over time: when the probability of a disaster is perceived to increase, the price of equities drops substantially. The prices of government bills tend to drop by a much smaller amount than the prices of private securities, even though the probability of an

explicit default or an inflationary blowout also rises during these times. This is because there is an increase in saving when the probability of a disaster increases, and these savers prefer to hold relatively low risk government bills.

One implication of these theories is that *average* risk premiums (averaged over high risk and low risk periods) may be much higher than the risk premiums used by the private sector in normal (low risk) times. If a government uses an average market risk premium to discount projects, it may well be discounting at a rate higher than that used by the private sector except at times of considerable economic stress. Boyle (2005) estimated the way the price of risk varied over time in New Zealand, using data from the period 1970 - 2003. He estimated the average risk premium was 3.6 percent for 30 of the years between 1970 and 2003, just over 25 percent between 1988 and 1991, when New Zealand experienced a financial crisis resulting in the collapse of numerous large companies, and 6.4 percent overall. The average return, therefore, would appear to embody a large liquidity risk premium. If the government uses the average return obtained from the private sector as a guide to the return it needs, it may be ignoring the liquidity benefits it provides by issuing securities that are much less likely to lose value in times of deep economic stress.[17]

# 3 Liquidity, balance sheet structure and discount rates: implications for Government

## 3.1 Eight propositions

This paper has two main arguments. The first is that the government should adopt an explicit two-stage process to evaluate investment projects. This process unbundles a project's risk into fundamental earnings risk and liquidity risk and links the liquidity risk to the government's balance sheet structure. The second argument is that the liquidity discount a government chooses, and the quantity of projects it undertakes, will depend on whether it finances the projects through debt or taxes. Projects financed through debt will normally require a lower discount, as they enhance the liquidity position of household. Consequently more projects should be undertaken when they are debt rather than tax financed as they are less costly to households.

These two arguments can be summarized as eight propositions, six of which stem directly from the literature reviewed in section 2.

[17] Consider how the private sector would have approached an investment paying a 6 percent return. It would have undertaken the investment on 30 out of the 34 years, but between 1988 and 1999 it would have avoided these investments, not just because many companies were experiencing considerable economic distress, but those not experiencing distress would have had better opportunities. In contrast, if the government has adopted the average discount rate, it would have never undertaken the investment. As this example shows, if the government used a high *average* discount rate to evaluate investments, it would avoid making moderate yielding investments that the private sector would be prepared to undertake on many if not most occasions, based on the reluctance of the private sector to undertake these investments on a few occasions.

**Proposition 1 [Section 2.2]**

When households and firms invest in assets, they distinguish between the asset's fundamental earnings risk and its liquidity risk - the risk that the resale value of the asset will be different than they expected, not because earnings are different than they expected, but because of variations in macroeconomic discount rates or because of changes in the liquidity of the asset. Only a small fraction of price fluctuations reflect fundamental earnings uncertainty.

**Proposition 2 [Section 2.2]**

Private sector agents price these two types of risks differently. A higher premium must be paid to induce agents to be exposed to fundamental earnings risk than liquidity risk, because fundamental earnings risk is more persistent. However, households and firms also have to be paid a liquidity premium to hold securities that are difficult to sell or which have uncertain resale value. Because of this liquidity premium, they will pay high prices for securities that are easy to sell at predictable prices even if they have low expected returns.

**Proposition 3 [Section 2.3]**

Firms structure their balance sheets in response to liquidity issues. When contemplating new investments, they take into account the circumstances where the cashflow needs or resale values of these investments may create liquidity problems that threaten the existence or the productive operation of the firm. When purchasing assets that are difficult to sell they may issue additional equity or use internal financing rather than debt financing to minimize liquidity risks. They place higher value on liquid rather than illiquid assets – or, equivalently, they use lower discount rates to evaluate liquid rather than illiquid assets. Thus firms contemplating investments simultaneously determine the discount rates they use and their balance sheet structure according to the liquidity of these investments.

**Proposition 4 [Section 2.3]**

The leading conceptual approach for valuing non-marketable assets is based on options pricing techniques. The value of a non-marketable asset can be calculated by (i) discounting its future earnings or benefits using the (low) discount rate appropriate for discounting an asset with fundamental earnings uncertainty but no liquidity risk, and (ii) subtracting the value of an option reflecting the illiquidity of the asset. Since the combined discount applied to illiquid assets (the fundamental earnings discount plus the liquidity discount) increases at less than an exponential rate, discount rates for illiquid assets decline with the investment horizon.

**Proposition 5 [Section 2.4]**

Governments have a comparative advantage at managing liquidity risk due to their ability to raise taxes from current and future generations. This allows the government to issue highly liquid debt securities at lower interest rates than private sector firms. The margins between private and government interest rates are also strongly counter-cyclical (Fama and French

1989). This means governments do not need to be as concerned about liquidity risk or fluctuations in the resale value of their assets as the private sector, even if they have the same concerns about fundamental earnings risk.

**Proposition 6 [Section 2.4]**

Because private sector entities often find it difficult to borrow against their future incomes, the government may be able to raise society's overall welfare levels by providing private firms and households with highly liquid government securities. These securities enable the private sector to better manage the liquidity risks they face. For this reason, holding the present value of taxes constant, households and firms are likely to prefer the government to finance its investments by issuing debt that is repaid from future taxes rather than by collecting the taxes immediately. Debt financing means households are provided with highly liquid securities that they can use in the event they need liquid assets, whereas investments financed from current taxes reduce the liquidity of households as they cannot always borrow against future incomes. Investments that are financed by issuing debt also have the advantage that they can be financed on an intergenerationally neutral basis.

To complete the argument, these six propositions need to be supplemented by two more.

**Proposition 7**

If a government were to emulate private sector methods to discount its investments, it would adopt a two-stage process that separates fundamental earnings discounts from liquidity discounts.

1. The government would first calculate the hypothetical 'fundamental earnings' value of the asset as if it were fully liquid, by discounting the asset's future costs and benefits using a relatively low discount rate that reflects the fundamental earnings uncertainty of the asset.
2. The government would apply a second discount that reflects the difficulty of raising funds by selling the asset. If the asset were non-marketable, this is equal to the value of a put option giving the Government the right to sell the asset as if it were fully liquid.

The value of the second discount depends not only on the innate liquidity of the asset, but on the costs governments face if they have to raise funds but cannot sell assets. The values of these options are more complex to determine than the value of normal options. The liquidity option value for different non-marketable assets will primarily depend on the horizon of the projects and the government balance sheet, not the characteristics of the assets themselves as they cannot be sold. Given a government's ability to borrow in a wide range of circumstances, due to its powers to raise taxes, the value of the option is likely to be small. If the value of the put options for different assets are similar – as to a first approximation they should be if the horizon

of the projects is similar – the relative ranking of the assets will depend on the fundamental earnings discount, not the common liquidity risk.

The information requirements necessary to calculate the liquidity discount mean the second discount should be calculated and imposed by a specialist central agency overseeing the overall balance sheet position of the government, not the agencies responsible for a considering the costs and benefits of a particular investment.

As the quantity of projects the government undertakes should reflect the same balance sheet criteria that determine the liquidity discount, this two-stage process simultaneously determines the combined discount rate (the fundamental earnings discount and the liquidity discount) with the quantity of projects that are undertaken. If a government is heavily indebted, the liquidity discount associated with an additional project will be high and fewer projects should be undertaken as fewer will have positive value once they are discounted for fundamental earnings risk and the higher liquidity risk. Conversely, if the government has low debt levels, the liquidity discount will be relatively modest, suggesting it is appropriate for the government to undertake a large number of projects. The way this process integrates decisions about the quantity of projects governments undertake with the discount rates they use and the structure of their balance sheets mimics the way private sector firms simultaneously alter the discount rates they use and their balance sheet structure in response to the quantity and type of projects they undertake.

The two-stage process implicit in Proposition 7 is quite similar to the current practice of the New Zealand Government. Currently the government uses a high discount rate to rank projects and then makes a decision about the number of projects that proceeds. The criteria for this decision are not always formally identified, but typically reflect the government's willingness to issue new debt, which in turn reflects the government's concerns about future tax rates and its ability to raise debt in the face of future liquidity demands. Proposition 7 formalises this process and suggests two modifications. First, the first stage discount used to rank projects should not be so high. Currently it is based on the total weighted cost of capital of the private sector - that is, it reflects private sector decisions that incorporate both fundamental earnings and liquidity discounts. These discounts need to be unbundled by the government so that the first stage discount that is used to rank projects only reflects the fundamental earnings discount. As the liquidity discount is incorporated into the second 'rationing' stage of the current process, the current process is essentially imposing a triple discount, which creates a bias against projects that have long horizon benefits. Secondly, Proposition 7 provides a more formal set of criteria for calculating the liquidity discount, including the way that real option pricing theory might be used to value the liquidity costs of investing in extremely illiquid assets.

**Proposition 8**

Because households have a preference for liquid securities, members of a society can be better off if they invest in low yielding, highly liquid government securities backed by government investments that have low expected returns rather than high yielding, illiquid private sector securities backed by private sector investments that have high expected returns.

Proposition 8 provides a new perspective on Arrow and Linds' (1970) famous question: are there circumstances where it is advantageous for a society to invest in low yielding, low risk public assets rather than high risk, high yielding private sector assets? The new answer is 'Yes': even if the systematic component of the fundamental risk of private and public assets is the same, investments in low yielding public assets may be preferred because the government can finance them by issuing securities that are more liquid and thus more highly valued than private sector securities.

If the government adopts this two-stage process, three sets of questions need to be answered.

1. How are the appropriate discount rates used to evaluate government investment and expenditure projects calculated?
2. What is the appropriate mixture of tax and debt financing used to finance these investments?
3. What determines the optimal mix of government and private sector investments?

## 3.2 What are the appropriate discount rates to evaluate government investment and expenditure projects?

Private sector firms use discount rates that reflect concern for fundamental earnings risk and liquidity risk. What is the appropriate fundamental earnings discount rate? This is clearly a key question, but not one that has been satisfactorily answered in the literature. While Campbell and Vuolteenahos' (2004) provide a useful conceptual approach, their estimate of the price of fundamental earnings risk by is too imprecise to be useful. Alternative approaches exist. One approach is to estimate the average expected return earned by the world's largest and least risky corporations, using the techniques Fama and French (1993) used to estimate their three factor model. These firms have much smaller liquidity problems than smaller firms, and thus provide guidance as to the importance of fundamental earnings rather than resale risks. The data in Table 1 suggests that shares issued by the largest firms with the smallest book/market values have expected returns of approximately 5% per annum. An alternative approach is suggested by Baumstark and Gollier (2014). Using a consumption CAPM approach, they argue the government discount rate should equal the sum of a risk free rate plus a project-specific fundamental risk premium equal to a risk premium multiplied by the covariance between a project's return and aggregate consumption fluctuations. This covariance may be positive for roading projects (because the value of an improved road depends on the opportunity cost of

time, which is positively correlated with income), but may be near zero for medical projects if the quantity of government sector medical services is uncorrelated with the economic cycle. Baumstock and Gollier (2014) suggest the socially efficient discount rate for France equals 2+ 3β percent, where β is the beta coefficient of the project under consideration, based on their view that the risk free discount rate is 2% and the consumption CAPM risk premium is 3%. If, as they argue, the beta coefficients for government projects as a whole is 1, this also suggests a real discount rate of about 5% per annum. A third approach is to use an estimate of the annual average returns expected by private sector firms that excludes periods of financial crises, when private sector asset prices are very low and expected returns are very high. The low asset prices during these crises reflect investors' concerns that firms have insufficient liquidity to remain in business, an issue of little relevance to the Government. When these periods are excluded, the expected return declines substantially, as Boyle (2005) showed for New Zealand. For the period 1970-2003, excluding the prolonged recession from 1988- 1992, he estimated that annual expected returns were equal to 3.6%.

The liquidity discount is conceptually difficult to calculate although the option modeling approach of Longstaff (2014) provides both conceptual and practical guidance. Consider an investment in an asset that is unlikely to ever be sold. Theoretically, the liquidity discount reflects the additional amount a government would be willing to pay to invest in a hypothetical asset that has exactly the same costs and benefits, but which could be sold for at any time. The additional value fundamentally reflects the value to the government of being able to sell the asset instead of borrowing should it need to raise additional funds. As discussed in section 2.4, this value depends on the range of shocks the government is likely to experience, the extent that the interest rate premium on new debt issues increases with its debt position, and the deadweight costs associated with higher taxes. Unlike private sector entities, it does not reflect the possibility that the government will be shut down if it cannot fulfill its debt obligations, although there are other consequences if a government defaults.[18]

Two points should be noted about this discount. First, for the reasons indicated above, the option value is likely to be a lot lower for a government than it is for private sector firms. Their powers of taxation mean many governments have little difficulty issuing debt, even with debt/ GDP ratios in excess of 100 percent of GDP, as governments have little risk of being shut down. Since governments can easily borrow, they have much less need to sell assets during a liquidity crisis, so the value of being able to sell an asset to raise funds is much lower than the corresponding value to private sector entities.

Secondly, while the liquidity discount depends on asset's liquidity and lifespan, the option value for different non-marketable assets that have the same lifespan should be identical. This

[18] The textbook theoretical discussion of these costs is chapter 6 of Obstfeld and Rogoff (1996). Reinhart and Rogoff (2012) use a large number of historical episodes to discuss the size of these costs.

means non-marketable assets can be ranked just using the relatively low discount rate associated with fundamental risks. The liquidity discount for a non-marketable asset provides an estimate of the maximum discount that should be used for more liquid assets and provides an upper limit of the disadvantages of investing in non-marketable rather than liquid assets.

Figure 2 provides a conceptual diagram outlining the difference between the liquidity discounts likely to be used by the private and government sectors. The horizontal axis represents the illiquidity of an asset, and the vertical axis represents the illiquidity premium needed before an investment is undertaken. If the conditions for the Modigliani-Miller theory applied, the relationship would be a horizontal line, as firms could borrow against the value of their assets no matter how liquid or illiquid they were. Relative to this ideal, a government with little debt would have a gently upward sloping illiquidity premium curve, whereas a government with considerable debt would have a curve that was both higher and more steeply sloped. Private sector firms typically require higher premiums again, as they don't have the same ability to borrow as governments. As private sector firms invest in more illiquid projects and shift along their curve, they require higher returns and alter their balance sheet structures. Note that the private sector's comparative disadvantage at liquidity management means it is much less likely to invest in the types of non-marketable assets in which the government routinely invests.
If the government adopts this two-stage process, the main result will be to increase the value of projects that generate returns in the distant future relative to those whose returns have shorter horizons. This is because the 'option' value of illiquidity discounts increases much less slowly with the horizon of the project than the fundamental earnings risks. Figure 2 and Box 1 provide a hypothetical example of the difference that might occur when a 10 year and a 30 year project are compared using an 8% exponential discount rate or a two-step discount procedure that combines a 5% fundamental earnings discount rate and a separate liquidity discount.[19] The value of the 10 year asset is more or less identical under the two discount procedures, whereas the value of the 30 year asset is considerably higher when the combined approach is used. This result is typical: when the government uses a single (high) discount rate that combines the liquidity discount and the fundamental risk discount into a single measure, it undervalues projects with long horizon cashflows. It will be recalled that Lettau and Watcher (2007) demonstrated a similar result when they explained the differences between growth and value stocks in private equity markets.

[19] The relative size of the liquidity discounts is based on the calculations used by Longstaff (2014: Table 1, column 1) to calculate the liquidity discounts for private firms. In practice the discount may be smaller than this because of the government's comparative advantage at borrowing.

Figure 2: Schematic diagram of the illiquid premium required for different investments

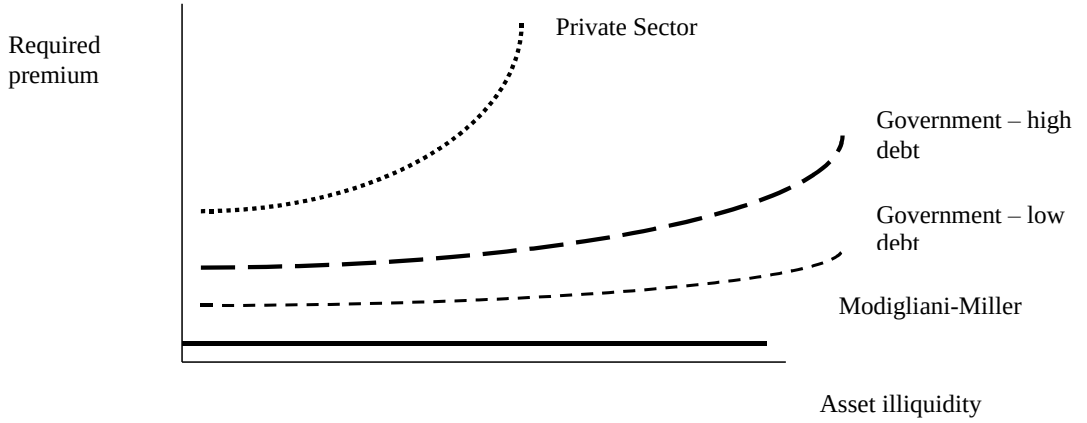



Figure 3: Exponential discount rates and liquidity option discounts

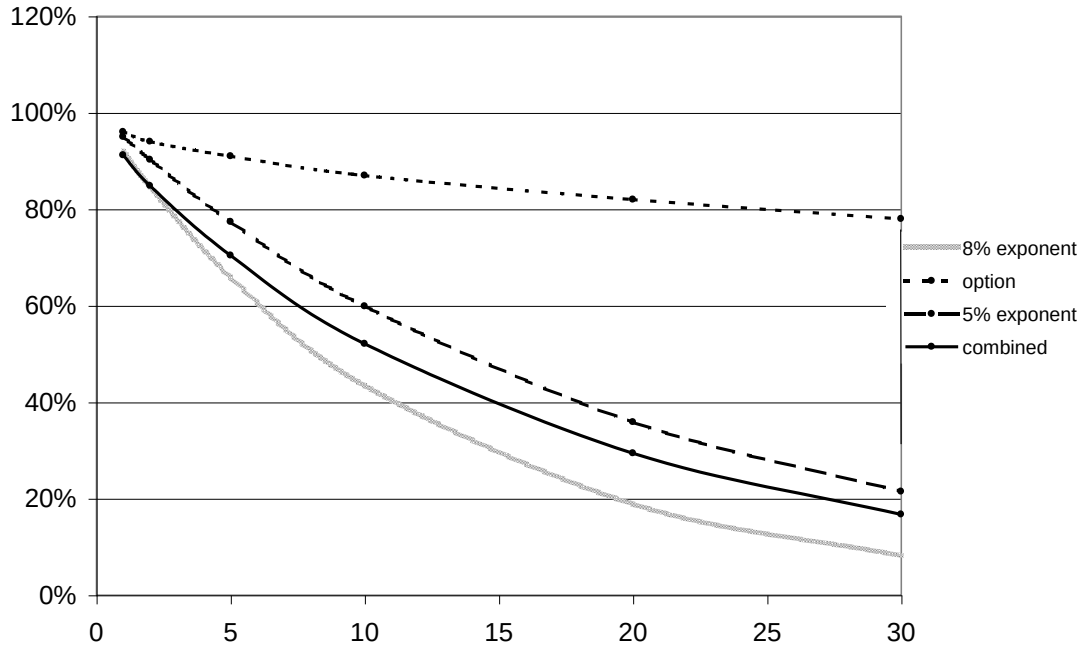



Figure 3 shows the discount rates at different horizons. The 'option' line shows the value of the second 'liquidity discount' that should be applied to a non-marketable asset. The '8% exponent' line shows the effect of an 8% exponential discount rate, while the 'combined' line shows the combined effects of a 5% exponential discount and the second 'liquidity discount'.

## 3.3 What is the appropriate mixture of tax and debt financing used to finance Government investments?

The discount rate used by the government to discount investment projects should depend on the mixture of financing the government uses. This statement would not be true if taxes could be levied in a non-distortionary manner and households could borrow unlimited amounts at the same rates at which the government borrows, for then households could borrow to pay their tax obligations whenever they had liquidity needs. But in the real world, households should prefer debt-funded rather than tax-funded government investments for two reasons. First, debt-funding allows tax-smoothing, which reduces the distortionary effects of taxes. Secondly, it reduces the liquidity constraints on households by giving households that provide cash to the government a liquid government security in exchange for their cash. This preference means households should be willing to accept lower returns on a project that is funded by debt rather than taxes. Put differently, investments that are funded upfront by taxes need to provide higher benefits than projects funded by debt, for they impose higher costs on a country's citizens.

These advantages of debt-funded investments are offset by a disadvantage – debt funding raises the debt levels of government. This reduces the ability of future governments to borrow, and tends to increase the interest rates that governments pay. The 'real option' cost of the increase in debt (discussed in section 2.4) provides the basis for the liquidity discount the government should apply to its investments. In addition, if an increase in debt leads to an increase in government borrowing rates, the effective cost of debt financing is higher than the headline interest rate. If a 1 percentage point increase in the debt/GDP ratio raises the interest rate on government debt by $\theta$ basis points, if the debt/GDP ratio is $\lambda$, and if the interest rate on government debt is r, the marginal cost of issuing debt to fund a new project lies between r and $r+\lambda\theta/100$ according to the extent that existing debt is rolled over and re-priced at the higher rate.[20]

The trade-off between the costs and benefits of funding government investment projects with debt or taxes suggests that investment projects should be funded in one of three ways. If the costs of issuing debt are lower than the costs of raising taxes, either because the real option cost of debt is low or because the deadweight costs of temporarily high taxes are high, then the project should be debt funded. Conversely, if the costs of issuing debt are higher than the costs of raising taxes, normally because debt levels and the real option cost of new debt is very high, projects should be funded by taxes. Finally, if neither of these conditions hold, a mixture of debt and tax funding should be used, with the proportions chosen to ensure that the costs of tax and debt funding are equalised at the margin. When debt levels are low 100% debt funding is likely to be optimal.

[20] Most countries issue long term debt to minimize the speed at which the debt is re-priced, but this factor can be material in countries which mainly issue short term debt.

**Box 1: The effect of the two stage discount procedure**

The following table shows the effect of the two discounting regimes on two different assets. The first asset pays $200 per year for 10 years, while the second asset pays $120 per year for 30 years. When they are discounted at an 8% discount rate, the two assets have almost identical values. When they are discounted at a 5% real rate and a second liquidity discount is applied, the value of the ten year asset is unchanged, but the 30 years asset is more valuable. Note the liquidity discount is higher for the 30 year asset than the ten year asset.

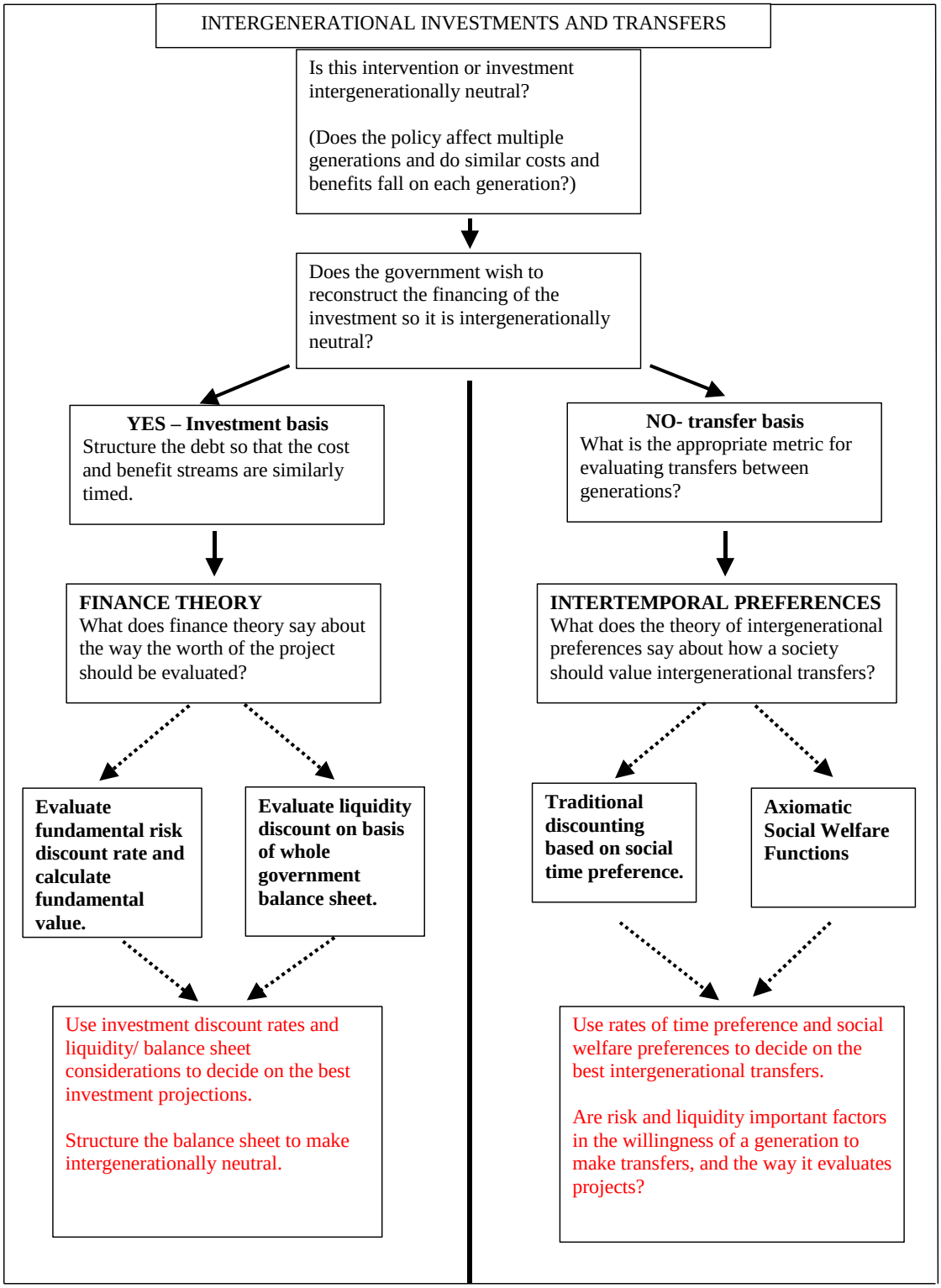
| | 8% exponential | 5% exponential | Liquidity discount | Combined 5% + liquidity |
|---|---|---|---|---|
| 10 year, $200 pa | $1342 | $1544 | 87% | $1344 |
| 30 year, $120 pa | $1351 | $1845 | 78% | $1439 |

An additional feature of debt-funding is that it allows an investment to be funded on an intergenerationally neutral basis. By issuing debt to fund the construction costs of a project, and by subsequently levying taxes to repay the debt, the government can arrange payments so that the cohorts that benefit from the investment service the loan. Government expenditure need not be intergenerationally neutral, but if it is not some generations will be required to pay taxes to make transfers to other generations. When one generation willingly makes transfers to another, this state of affairs seems reasonable. If a generation dumps expenses on other generation without attempting to providing matching benefits, however, the other generation may legitimately feel aggrieved.

If a government investment project is funded on an intergenerationally neutral basis, it seems reasonable to require the welfare gains obtained by each generation should equal or exceed the welfare gains that could be obtained from investing the funds in private sector investments. (The difference between this requirement and the requirement that the expected returns from government and private sector investments are equalized is discussed further below). If a generation chooses to fund an investment by gifting resources to subsequent generations, however, there is no obvious reason why the welfare benefits gained by these generations should equal the gains that could be obtained from a private sector investment. After all, a gift is a gift is a gift. For this reason, if a generation chooses to raise taxes up-front to fund an investment that lasts for several generations, it is not unreasonable for it to require a lower rate of return from the investment than if it funds the it through debt, even though tax-funding imposes higher costs on itself. If it funds the project in advance, it can be considered a gift to subsequent generations, whereas if it is debt funded the project should be expected to be

sufficiently beneficial that subsequent generations will not regret the debt servicing costs they face.

Figure 4 :Flow diagram describing the difference between intergenerationally neutral investment projects and transfers.



These considerations suggest that the first step in any assessment of the discount rate to be used for a government project should be to assess whether the project is to be funded on an intergenerationally neutral basis or not (see Figure 4). If the project is intergenerationally neutral, it is perfectly appropriate to discount the costs and benefits of the project using the process outlined above, so they can be compared with the best alternative use of the funds including private sector investments. If the project is not funded on an intergenerationally neutral basis, it may be appropriate to discount that component of the project that is a tax-funded gift or transfer to (or from) future generations using different criteria. It is not the intention of this paper to discuss the vast literature on how social discount rates to evaluate *transfers* should be constructed (the reader is referred to articles by Arrow et al (1995), Arrow 1999, Bazelon and Smetters (1999), Casey, Heerdagen and Scobie (2007), Chichilnisky (1996), Groom et al (2005), Ramsey (1928) and Weitzman (1998) for a sample). Suffice to say, there are many possibilities discussed in the literature, and in general they are different from the process discussed here to be used to discount *investment* projects.

## 3.4 What determines the optimal mix of government and private sector investments?

What are the macroeconomic effects of the government using debt to finance its investments? This topic has proved controversial. The prevailing view amongst economists has been that the government will crowd out private investment if it issues debt to fund its own investments.[21] If this is the case, government investments will only increase total economic returns if the return to government investments exceeds the returns to private sector investments. If the government sector discount rate is lower than the private sector discount rate, however, this will not be the case.

Arrow and Lind (1970) argued that it is not necessary for the expected returns from government investments and private sector investments to be equal, as this criteria does not take into account the different risk levels of government and private sector investments. If a private sector investment has an expected return of 10% but this return is only valued the same as a riskless asset returning 5%, a government investment with an expected return of only 6 percent provides better value to society if its risk adjusted value is also 6%. Arrow and Lind argued this was possible because the government invested in a wide range of projects with random returns, which effectively reduced the aggregate riskiness of its investments to zero. This position has been significantly criticized by many authors, however (for a review see Klein 1997 or Baumstark and Gollier 2014).

[21] Holmström and Tirole are exceptions, suggesting that since Government debt enhances the liquidity position of private firms, it may increase private sector investment.

The approach taken in this paper is similar to that of Arrow and Lind, but for a different reason. Because the government can provide much less risky financial securities than the private sector, households may prefer low yielding government securities backed by low yielding public investments than higher yielding private securities backed by higher yielding private investments. The additional expected return from private investments is not valued because of the additional risk. The government advantage does not come from its ability to manage fundamental earnings risk better than the private sector, however. It comes because it can manage liquidity risk much better. Private sector firms are much more subject to liquidity crises than the government, crises that can bankrupt them in ways that rarely trouble governments. The premium households require to invest in risky private sector securities is testament to the amount that household fear these risks. These advantages are most obvious during banking crises, when government's often find themselves exchanging large quantities of low interest securities for private sector securities no-one else is willing to hold. As Barro (2006) documented, much of the willingness of investors to hold low yielding government debt rather than high yielding private sector securities stems from the very low returns earned by the private sector during financial crises and other economic disasters. Indeed, Fama and French (1989) documented a sharp increase in the difference between corporate debt rates and government debt rates during recessions, a difference that reflects the substantial liquidity advantage the government has at managing liquidity.

It is important to emphasis that the governments advantage does not stem from its ability to manage fundamental risk. If a government project has much lower earnings or benefits than expected, or which has much higher future costs than expected, there are real costs imposed on households. These costs usually take the form of higher tax payments. The analysis in this paper explicitly takes these potential costs into account by including a fundamental risk premium in the fundamental earnings discount rate that the government should use, just as private sector investors include a fundamental earnings risk term in the discount rate they use.

This reasoning suggests that if the government issues debt to fund investment projects, it should not be bothered if it uses a discount rate that is lower than that of the private sector so long as it uses a similar *procedure* to discount fundamental earnings risk. The government's comparative advantage at managing liquidity risk, means it can issue low yielding securities that are preferred by households over the higher yielding securities issued by private sector firms even if it invests in projects that have lower expected returns.

### *3.4.1 Governance issues.*

If the government can make households better off by issuing low yielding, highly liquid securities against low yielding non-marketable assets, could it not also make households better off by issuing low yielding, highly liquid government securities and use the proceeds to purchase high yielding but illiquid private sector assets? The answer is 'yes'. However, with the exception

of assets placed in sovereign wealth funds, it is usually argued that the government should only purchase assets with which it has a comparative advantage in managing, such as roads or hospitals, because the private sector is better at managing productive companies. Thus rules are needed to prevent governments from using their ability to issue low-interest rate debt to undertake projects for which it is not well suited, or to directly invest in assets normally operated by the private sector. In practice, most governments around the world do adopt such rules, although the boundaries of these rules are often nationally or culturally specific. The New Zealand public believes it is appropriate for the government to build and maintain roads and hospitals for instance, but not operate trucking companies or hotels. The public in the United States also disapprove of the government owning trucking companies and hotels, but there is less acceptance that the Government should own hospitals.

The exception is sovereign wealth funds. In some countries governments attempt to reduce future tax rates by creating a central fund that invests in a wide range of private securities instead of repaying debt. The government's comparative advantage at liquidity management means it can earn a premium from investing in relatively illiquid assets without fearing the consequences of the temporary price changes that occur due to changing discount rates. Should governments take advantage of these opportunities if they want to better manage their long term receipts and expenditure flows? Although this discussion is politically charged in many countries, the economics seems reasonably straightforward. If the government can purchase private sector securities without intervening in the governance of the companies that issue them, the returns it earns are likely to more than offset the risks it faces, because of its ability to weather liquidity crises without needing to sell assets (Merton 1983). The amount it invests will depend on the objectives of the government and its willingness to hold assets that have fundamental earnings risk. As Bohn (2005) points out, there are many circumstances where the government should be willing to invest in foreign assets, as this may reduce the risks faced by households because their labour market earnings are primarily exposed to the domestic economy. Once again, however, much will depend on having governance arrangements that allow the investment fund to invest in a manner that is protected from the whims of politicians, and which ensures that the investment fund does not interfere with the operation of private companies.

# 4 Conclusion

Many governments around the world wish to evaluate their investment opportunities using a similar framework to that used by the private sector. The New Zealand government is no exception, and for the last four decades years it has a adopted a variant of the capital asset pricing model used by the private sector to evaluate risky investments. In particular, the government has discounted the potential costs and benefits of government projects using a real

discount rate of 8% or more, in the belief that this rate reflects the rate used by the private sector to discount risky projects.

Recent advances in economist's understanding of the behaviour of firms and financial markets suggest that this practice is based on an outmoded understanding of the way the private sector actually behaves. If a government wishes to use similar practices as the private sector, it needs to distinguish between an asset's fundamental earnings risks and its liquidity risk. If it does this, it should adopt a two stage discounting process that treats these different types of risks separately. In practice this means it should use a much lower discount rate to discount the fundamental earnings risk surrounding a project, and then apply a second discount to take into account the resale or liquidity risk. The rate for the fundamental earnings risk should depend on the rate at which the government can borrow and the way an investment's earnings co-vary with other economic variables, most notably private consumption. The exact rates would need proper research, although a reduction in the fundamental earnings discount rate to 4 – 5 percent would bring New Zealand back in line with standard international practice. If the government does not adopt this procedure, it will perpetuate a bias against high return, long duration assets, a practice that has significant potential to undermine the performance of the New Zealand economy.

This two-stage process mimics the ways that private sector entities structure their balance sheets in response to liquidity risks. They do this because private sector firms often need to raise funds at short notice, but can have difficulty borrowing or issuing new financial securities. Governments are much less affected by these risks, as they have little difficulty raising funds in response to liquidity shocks. Nonetheless, the ability of the government to raise funds in different circumstances is crucial to understanding the liquidity discount rates it should use. These rates should be calculated by a central government entity responsible for overseeing the whole of the government's balance sheet.

Many governments, including the New Zealand Government, already use a two-stage process when they evaluate investment projects. In the first stage, they use a discount rate to rank projects based on their projected earnings and benefits, while in the second stage they choose the total quantity of projects they undertake based on a variety of criteria including the government's overall debt targets. As such, the existing process already links the government's balance sheet to the effective discount rate it uses. The procedure recommended in this paper formalises this process. In doing so, however, it appears that the current practice of discounting projects using an 8 percent real rate (to reflect the average returns earned by the private sector) and then rationing projects according to the government's balance sheet targets imposes a triple discount as the liquidity discount is imposed twice. The appropriate way to avoid this triple discount is to use a lower discount rate in the first stage, a rate that will reflect the fundamental earnings risk not the liquidity risk.

This paper has primarily been concerned with investment projects that are funded on an intergenerationally neutral basis – that is, projects that provide benefits to generations in proportion to the extent that they fund them. There are several good reasons why these projects should be debt funded. If the government raises taxes to fund projects that transfer resources between generations, the need to use private sector investment criteria is diminished because these transfers are not necessarily made to obtain a commercial return. Paradoxically, while tax funded projects impose higher costs on households than debt funded projects, it may be appropriate to use lower discount rates for these gifts. This paper has not tackled the topic of the appropriate 'social' discount rate to use when the government is actively seeking to transfer resources between generations. The literature on this topic is vast and covered elsewhere. But since the appropriate discount rate to use for investments and gifts may differ, a first step in identifying the appropriate discount rate for any project is to identify the extent it is an investment and the extent it is undertaken as a means of transferring resources between generations.

Finally, even if the government uses the same discounting methodology as the private sector, this paper emphasizes that the expected rates of return from government and private sector projects do not need to be the same. Because the government is much less affected by liquidity risks than the private sector, households can be better off if they invest in highly liquid low-yielding securities issued by the government to finance projects with expected returns that are low relative to the returns expected from private sector projects. Private sector securities are typically much risky than government debt, because of the liquidity risks private sector firms face, and the possibility of lower returns from government investments is offset by the lower risk they entail.

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