
G Rates of return in Australia

G.1 The risk free rate of return

Asset holders have a return they expect to make over the period that they will hold the asset. The actual return is uncertain and may differ from expected returns – creating risk. Risk is the variance in actual returns around the expected return. An asset is risk free if the actual always equals the expected return.¹

A riskless asset should be free from all risk. Possible risks include:

- default risk, the risk that the seller of the asset will not make the required repayments;
- inflation risk, the risk that inflation will differ from its expected level, causing the real returns realised on assets which pay specified nominal amount to vary;
- reinvestment risk, the risk of interest rate changes when asset life differs from the investor's desired investment horizon, and;
- liquidity risk, the risk of being unable to sell the instrument for cash at short notice without significant costs.

The government bond rate is usually considered the riskless rate because the government can compel taxpayers to finance repayments, making default risk low. But many types of government bonds exist, with different returns. All government bonds are subject to some risk, and the risks vary across different types of government bonds. For example, most bonds offer to pay some nominal amount at a future date, subjecting bond holders to the risk of unexpected changes in inflation and making the real return from holding bonds risky. Unexpected higher inflation reduces their real return.

In the United States, economists tend to use the return on short term (90 day) Treasury Bills as the riskless interest rate. The inflation risk is small because of the short time period. US Treasury bills have averaged (over long time periods) an

¹ Damodaran (2008, p. 3).

annual realised real return of around 1 per cent.² It could be argued that the real return on short term bonds are negatively correlated with the market (the market does well in the short-run when inflation is unexpectedly high and poorly when inflation is unexpectedly low). If so, the short term bond return may understate the riskless interest rate.³

Bonds with a longer maturity have more inflation risk, because inflation further in the future is more difficult to predict, and inflation can vary much more over long periods. Consequently, the real yields on long-term bonds are uncertain. If they are positively correlated with the market (the market does poorly when inflation is unexpectedly high over long periods) then the expected real yield on long term bonds must be higher than the risk free rate to compensate.

On the other hand, long-term bonds contain less reinvestment risk than short-term term bonds. As Campbell points out:

For long-term investors, money market investments are *not* riskless because they must be rolled over at uncertain future interest rates. Just as borrowers have come to appreciate that short-term debt carries a risk of having to refinance at high rates during a financial crisis, so long-term investors must appreciate that short-term investments carry the risk of having to reinvest at low real rates in the future. For long-term investors, an inflation-indexed long-term bond is actually less risky than cash. A long-term bond does not have a stable market value in the short term, but it delivers a predictable stream of real income and thus supports a stable standard of living in the long term.⁴

To minimise reinvestment risk, the risk free rate used should match the duration of the cash flows being discounted. Most government projects have a long duration, and so short term bond rates are not appropriate.

Since 1986, the Australian government has issued inflation-indexed bonds, which offer a guaranteed real before-tax return, free from inflation risk. They tend to be long-term bonds with 10-year terms, an appropriate time period for long-term government projects.

Bonds may have different amounts of liquidity risk. For example, assets that sell in thin markets (when sales volumes are low and may easily dry up) have higher liquidity risk. The higher liquidity risk, the higher the premium investors require to hold the asset. Differences in liquidity risk could explain the low return to US

² See Goetzmann and Ibbotson (2005, p. 18); Mehra (2006, table 2.1, p. 5); Mehra (2003, table 1, p. 55) and Cochrane (2005, p. 21).

³ Sieper (1981, p. 23) and Summers (1990, p. 121).

⁴ Campbell (1999, p. 2).

Treasury Bills compared with Australian bonds (the US Treasury Bill market is the largest and most liquid market in the world).

Indexed bonds are less liquid than other government bonds, because its market is much smaller. It must pay a higher yield to compensate investors for this relative illiquidity. For example, in the United States, it is recognised that part of the return on Treasury Inflation Protected Securities compensates for lower liquidity, but that ‘does not appear to be constant and can change on a weekly basis’.⁵ The liquidity premium can become extremely high in times of financial distress. The inflation risk premium, however, is estimated to increase the returns on long-term nominal bonds, compared with indexed bonds, by about 1 percentage point

The expected real return on bonds is the nominal return less the expected rate of inflation over the period. Unfortunately, it is difficult to observe expected inflation. Some analysts use an estimate of expected inflation to estimate the expected real interest rate from nominal returns. For example, they take the nominal 10-year bond return (or some average of recent rates), currently around 6 per cent, and subtract the mid-point of Reserve Bank’s target inflation rate (2.5 per cent) to get a real return of 3.5 per cent.⁶ But the Reserve Bank’s target is often breached.

Another approach is to infer the expected real return from realised real returns. If inflationary expectations are unbiased then realised inflation would equal expected inflation plus an error term. The average of realised inflation rates over long periods would give the expected inflation rate.

Table G.1 sets out realised annual real returns on government bonds since 1971. Clearly inflationary expectations can be wrong for long periods of time. For example, realised real returns on short-term 90 day bonds were negative in the 1970s, a sign that inflation was higher than anticipated.

What is the relevant risk free rate for a project that gives a return over 10 years? A 90 day Treasury bill rate would not be risk free – because there is the reinvestment risk of being subject to interest rate changes when rolling over to new bills every 90 days and inflation risk. It may overstate or understate the true risk free rate. The expected return on a ten-year zero coupon bond would give the nominal risk-free interest rate, but the real return is subject to inflation risk. It overstates the risk free rate. The returns on indexed bonds may overstate the riskless real interest rate because of the liquidity premium.

⁵ From Federal Reserve Bank of Cleveland (2009).

⁶ For example, Access Economics (2006, p. 47).

It turns out that the returns on short- and long-term government bonds in Australia have been very similar, earning identical returns over the whole period and with average nominal returns each decade differing by less than 1 percentage point.

Table G.1 Government bond average annual realised returns 1971–2008 Australia
arithmetic means

<i>Time period^a</i>	<i>10 year govt bonds (nominal)</i>	<i>90 day bank accepted (nominal)</i>	<i>90 day bank accepted (real)</i>	<i>Indexed (from July 1986)</i>	<i>Inflation^b</i>
	%	%	%	%	%
1971–2008	9.2	9.2	2.9		6.2
1970s	8.4	8.7	–1.5		10.4
1980s	13.3	14.1	5.2	4.9	8.4
1990s	8.9	7.9	5.2	4.6	2.6
2000s	5.8	5.7	2.2	3.0	3.2
1987–2008	8.2	7.9	4.1	4.0	3.6
Standard deviation	3.2	4.0	3.5	1.0	4.2

^a Years are financial years. For example, 2007 is the year to 30 June 2007. 1970s is 1 July 1970 to 30 June 1979. ^b Inflation measured by CPI.

Source: Derived from tables at www.rba.gov.au.

The real return to short-term government bonds has averaged 2.9 per cent since July 1971. If we exclude the 1970s, the return is higher (averaging over 4 per cent for July 1986 to 2007). Further, measured inflation (such as the change in the Consumer Price index, CPI) overstates the true level of inflation, favouring an upwards adjustment in the riskless real interest rate over the realised real return on government bonds (including indexed bonds because their inflation adjustment payments over-compensate consumers for price changes). Researchers estimate that the US CPI overstates inflation by about 1 percentage point per year.⁷

These results are consistent with other studies on the real returns on government bonds in Australia. Real returns on 90 day bills averaged over 2 per cent real (arithmetic mean, geometric mean only slightly lower) from 1883-2005, 1958-2005, 1883-1957. But from the 1980s on, the real return rose to just over 4 per cent (with a 95 per cent confidence interval of about plus or minus one percentage point).⁸ Real ten year bond returns are about half a percent higher – 2.55 per cent for the long term and 4.5 per cent since the 1980s. Their confidence intervals are about the same.

⁷ See box 1.1.

⁸ The 95 per cent confidence interval is the mean plus or minus $1.96\sigma/\sqrt{n}$. For 90 day bank accepted bonds $\sigma = 3.5$ per cent. For a 27 year horizon, the confidence interval is plus or minus 1.3 per cent.

The long-term average real return on indexed bonds (from 1987) is very close to the realised real return on 90 day government bills (4.0 per cent v 4.1 per cent). Their return was lower than the return on bills in the 1980s and 1990s, but higher in the 2000s.

The realised real return on bonds has not been stable. For example, real rates were negative in the 1970s, averaged around 5 per cent in the 1980s and 1990s, and 3 per cent or less in the 2000s, changes unlikely to have happened by chance.⁹ A reasonable estimate of the before-tax riskless return in Australia is around 3–4 per cent. All government bonds likely pay a premium above the risk free rate to compensate for the risks they impose. On the other hand, because the CPI overstates inflation, realised bond returns may understate the true real risk-free return.

G.2 The market risk premium

The risk premium is usually measured by the difference in the return investors receive on a broad share market index and the government bond rate (a measure of the risk free return). This measure probably understates the share market premium over the risk-free rate because government bond nominal returns include a premium to compensate for the risks they impose (although the premium could be negative for short-term bonds).

Table G.2 summarises the realised real annual returns from July 1970 to June 2008 on a broad Australian share market index. Over that period, the real return averaged 6.7 per cent, giving a 3.8 per cent premium over 90 day treasury notes (which earn a return close to 10 year bonds, see table G.1). As both returns are deflated with the CPI, its overstatement of the inflation rate does not bias the estimate of the premium.¹⁰ These estimates do not account for imputation credits, and so understate the before-tax returns to individuals since imputation was introduced (on July 1, 1987). The Sharpe ratio, a measure of the ratio of reward to risk in asset markets (see appendix H), is the risk premium divided by the standard deviation in market returns (3.8 per cent/19.3 per cent) is 0.2.

⁹ With a standard deviation of 3.5 per cent, the 95 per cent confidence interval with 10 years data is plus or minus 1.1 per cent. For the inflation risk-free indexed bonds, the real return is more stable and the confidence interval with 10 years data is less than 1 per cent.

¹⁰ But the premium estimated from real returns is slightly lower from the one estimated from nominal returns because the real premium is $r_e - r_f$. The nominal premium is $(1+\rho_e) - (1+\rho_f) = (1+r_e)(1+\pi) - (1+r_f)(1+\pi) = r_e - r_f + \pi(r_e - r_f)$ where π is the rate of inflation, r_e is the return to equity and r_f the risk free return. Further, inflation may affect the different asset classes differently.

Table G.2 uses the arithmetic average of annual returns. When expected returns are constant (independently and identically distributed — i.i.d.), the arithmetic mean \bar{r}_a is an unbiased estimate of the expected rate of return, $E(r)$. If returns are uncertain and the time period is longer than a year, the arithmetic mean lies above the geometric mean, the annualized measure of the actual compounded change in the index over the period (as if there had been no volatility in return).¹¹ The difference will be greater the longer the time period and the greater the volatility.¹² The mean geometric return on shares from 1971 to 2008 was 5.5 per cent per year.

Table G.2 Realised real annual returns, Australia.^a
arithmetic average

<i>Time period^b</i>	<i>Share market index</i>	<i>Equity premium over 90 day bank accepted bills</i>	<i>Return to capital in the national accounts</i>
	%	%	%
1971–2008	6.7	3.8	8.5
Standard deviation	19.3	18.8	3.0
95 % confidence interval ^c	6.2	6.0	1.0
1970s	–5.6	–4.1	8.2
1980s	14.0	8.8	6.9
1990s	9.0	3.8	7.7
2000s (to 2008)	8.3	6.0	11.7
1980–2008	10.5	6.2	8.6

^a Nominal returns are deflated by the Consumer Price Index. ^b Years are to 30 June. 1970s is 1 July 1970 to 30 June 1979. ^c The confidence interval is the mean plus or minus this number (which is $1.96\sigma/\sqrt{n}$ where σ is the standard deviation and n is the number of observations).

Source: Vanguard http://www.vanguard.com.au/Personal_Investors/Tools_and_education/Calculators_and_tools/Index_chart/index.aspx; Dolman (2007) and www.rba.gov.au. The share market index prior to 1980 is the MSCI Australia gross total return Index. After 1980 it is the S&P/ASX All ordinaries Accumulation Index. The author converted nominal returns into real returns and calculated the equity premium.

Using the arithmetic mean to discount future payments over-estimates the correct discount factor and so the arithmetic mean understates the discount rate that should be used to discount cash flows. The discount factor for a payment received in n periods time is $[1/(1+E(r))]^n < E[1/(1+\bar{r}_a)^n]$ as \bar{r}_a contains estimation error that is compounded when transformed into a discount factor for payments received more than one period in the future.¹³ As the geometric mean is below the arithmetic mean, it is even more biased.

¹¹ If the index rises by x per cent over n years, the average annual geometric return is $(1+x)^{1/n}$.

¹² McCulloch (2003).

¹³ See Cooper (1996) p.160. Cooper also derives unbiased estimators of $[1/(1+E(r))]^n$.

The evidence is that returns are not i.i.d.¹⁴ Nevertheless, the arithmetic mean is likely to be closer to the true discount rate than the geometric mean if transient disequilibrium causes the serial correlation in returns. If the risk premium changes over time, required rates of return at any date would have to be estimated conditional on the set of variables that predict the risk-premium using the appropriate model.¹⁵

The geometric mean may be relevant if there is mean reversion in stock returns, where periods of relatively high returns tend to be followed by periods of relatively low returns and vice versa. There have been claims that long-horizon (two- to ten-year) stock index returns tend to follow a mean-reverting pattern.¹⁶ Cochrane argues that although aggregate stock returns show predictability over long periods, the evidence for mean reversion is weak.¹⁷

The risk premium is the extra return needed to compensate investors for the expected risk of holding shares and cannot be observed, as expected returns cannot be measured. We only observe realised returns – and negative realised premiums demonstrate that realised returns can differ greatly from expectations. Average realised returns estimate the true risk premium if expectations are correct on average.

The variance in market returns is so great, that the market return cannot be estimated precisely, even with 38 years of data. Over the past 38 years, the Australian share market real annual return has varied from 59 per cent to minus 36 per cent. The standard deviation in share market returns is 19.3 per cent, implying a 95 per cent confidence interval of plus or minus 6.2 percentage points. That is, we can only be 95 per cent certain that the market return lies somewhere between 0.5 and 12.9 per cent. Certainly, substantial estimation error is possible. The return is very sensitive to the starting and finishing dates of the measurement period. For example, measuring from 1980, the share market real return averages 10.5 per cent, a premium of 6.2 per cent over short term bonds.

Over any one decade, the realised equity premium has great variability. Although from 1970 to 2008 it averaged 3.8 per cent, it was negative in the 1970s and over 8 per cent in the 1980s.¹⁸ With only 10 years data, the 95 per cent confidence interval would be plus or minus 12 percentage points.

¹⁴ See the next section.

¹⁵ See Cooper (1996, pp. 163-65).

¹⁶ See Jones and Netter (2008).

¹⁷ Cochrane (2005, pp. 415-22).

¹⁸ Richards (1991, p. 11) finds a negative risk premium of -1.9 per cent for 1970-90.

More years of data can help pin down the estimated risk premium more precisely, but the standard deviation is still large, giving a 95 per cent confidence interval of at least plus or minus 3 percentage points even with 100 years of data.

Studies of the risk premium (over 10 year government bond returns) over long periods in Australia tend to find that it averages at least 6 per cent, often the estimates are over 7 per cent.¹⁹ Relative to Treasury Bills, the estimates are higher (usually about half a percentage point). Geometric returns are about 1.5 to 2.5 percentage points lower. The studies use data that goes back to 1883. But we cannot be certain that the average risk premium has been constant over long time periods. Does anyone believe the risk premium in the 1890s tells us much about today's market? The risk premium is not constant over the business cycle, but even the average premium over the cycle may have changed systematically over time, because of (for example) declining transactions costs of trading in shares, changes in the proportion of the population owning shares, changes in market risk, changes in companies' average gearing ratios and greater international capital flows. Also the relationship between bond and share market returns could change over time with changes in tax, such as the introduction of imputation and capital gains taxes, changes in tax rates, and with changes in the riskless rate.²⁰

To complicate matters, a decline in the risk premium that people require to hold equities would boost share prices. That is, realised returns jump, increasing the measured risk premium, when the true premium falls. Conversely, when risk premiums increase (as they have in response to the sub-prime mortgage crisis), realised returns fall. In 2008-09 (to February 28) the Australian share market fell by 33 per cent in nominal terms (more in real terms). That reduces the measured average risk premium since 1970 by more than 1 percentage point, just when actual risk premiums have risen. The effect on 100 year estimates of the risk premium would be small.

Dimson et al (2002) estimate global equity premiums from 1900 to 2001. They find Australia's equity risk premium to be 7.9 per cent over ten year bonds (8.5 per cent over bills), above the world average of 5.4 per cent (5.9 per cent over bills). Australia was unusual in having higher risk premiums (over bills) in the first 50 years of the 20th century than in the next 52 (about 9.25 per cent v 7.75 per cent, whereas for the world it was 4.1 per cent v 7.7 per cent arithmetic average).²¹ In

¹⁹ Brailsford et al. (2007) provide a comprehensive study of equity, bond and bill rates for varying time periods dating back to 1883. See also Gray and Officer (2005); Lally (2005); Dimson et al. (2002) and Bishop (2007).

²⁰ Gordon and Gould (1984) find this with Canadian data. Merton (1980) finds that risk has changed substantially over time.

²¹ Dimson et al. (2002).

contrast, Brailsford et al (2007) find a premium over bills of 6.8 per cent from 1900 to 2001, and from 1883 to 1957 of 6.4 per cent and 1958 to 2005 (chosen because the data quality is better after 1958) of 6.8 per cent.

An alternative approach to estimating the market risk premium is to use the equation of yield. At any point in time the expected annual rate of return on an asset is given by: $r = D/P + \Delta P/P$ where D is the expected cash flow (dividend payment) over the year, P is the price of the asset and ΔP is the expected capital gain over the year. D/P is the dividend yield and ΔP the expected rate of capital gain. All the terms should be consistent (e.g. in nominal terms for the nominal return, in real terms for the real return).

The equation of yield comes from the present value equation for an asset's price:

$P_t = D_t/(1+r_t) + D_{t+1}/(1+r_t)(1+r_{t+1}) + D_{t+2}/((1+r_t)(1+r_{t+1})(1+r_{t+2})) + \dots$ is the asset price at the beginning of time t (with cash flows received at the end of the period) where r_i is the expected rate of return in period i .²² The price of an asset is the present value of its expected future cash flows. The equation holds for expected returns (where each term is the expected value) and also defines realised returns.

For the share market, the real expected return is $r_f + e = D/P + \Delta P/P$ where r_f is the expected risk free return and e is the risk premium.

Some experts conclude that a substantial part of the long term 6 to 8 per cent equity premium was luck – such as avoiding a world war or depression over the past 60 years, and the true equity premium is closer to the 4 per cent of recent decades. That is, people have learnt the true distribution of returns is better than originally thought. Share prices would increase as people revised downwards their expectation of these events occurring, and the average of past capital gains would over-estimate expected future capital gains. That is, past realised returns overstate expected future returns and so the average equity risk premium in the past is an over-estimate of expected future risk premiums.

Instead of estimating the expected capital gain with past capital gains, authors use the past growth in dividends or the expected growth in GDP (usually based on past growth rates) to estimate the expected capital gain. Then plugging in values for the expected dividend yield and risk free rate gives the expected risk premium. Alternatively, plugging in the realised average dividend yield and risk free rate over

²² Likewise, $P_{t+1} = D_{t+1}/(1+r_{t+1}) + D_{t+2}/(1+r_{t+1})(1+r_{t+2}) + D_{t+3}/((1+r_{t+1})(1+r_{t+2})(1+r_{t+3})) + \dots$. Substituting this into the expression for P_t gives: $P_t = D_t/(1+r_t) + P_{t+1}/(1+r_t)$ which can be written as: $r_t = D_t/P_t + (P_{t+1} - P_t)/P_t$ which is the equation of yield.

long time periods gives the average past expected risk premium. Most people find it to be in the range of around 2.5 to 5 per cent.²³

The trailing dividend yield measures the past 12 months dividends divided by the current share price (and so is a real return). It averaged between 3 and 4 per cent between 2002-03 and 2007-08. In 2007-08 it rose steadily to its current level (as of February 2009) of above 7 per cent (over 9 per cent when grossed up to account for franking credits), close to all time highs in Australia.²⁴ Although the expected dividend yield could be lower – especially because 40 per cent of companies announced a cut in dividends in the previous month – the high dividend yield (and low bond yield) indicate that risk premiums are high (which is typical in a recession). With a dividend yield of 7 per cent, risk free rate of 2 per cent and expected capital gain of 2 per cent, the risk premium is 7 per cent.

The long-term average dividend yield is around 4 per cent, the long-term risk free rate around 3-4 per cent and real growth in dividends (or, alternatively real growth in GDP or earnings) around 3 to 4 per cent. The equation of yield implies the expected risk premium has averaged around 3 to 5 per cent.

The equity premium is large. At around 3 to 8 per cent it is larger than the risk free rate, and so constitutes more than half of the market return. The quantity and price of an asset's risk is a major determinant of its value. The size of risk premium to include in a project discount rate makes a huge difference.

The growth in dividends and risk free rate are both fairly stable. If the expected return were constant, that would imply that the expected capital gain would equal the expected growth in dividends and the expected dividend yield would be constant. Realised returns would fluctuate randomly around the expected return.

But the dividend yield changes over time, which means returns are not i.i.d. Price/dividend ratios can only move if they forecast future returns, if they forecast future dividend growth or if there is a bubble (where the price/dividend ratio would

²³ For example, in the United States, the realised equity premium averages around 6-8 per cent for long periods. Using the expected capital gains approach, DeLong and Magin (2009) p. estimate 2.5 per cent, Fama and French (2002) between 2.5 and 4.3 for 1951-2000, Jagannathan, McGrattan and Scherbina (2001) estimate from 3.4 per cent to 5.9 per cent from 1926 to 1999. Siegal (2004) estimates the future risk premium to be 3 per cent. McCulloch and Leonova (2005) provide a nice survey of the evidence. They conclude the equity risk premium is in the range 3 to 5 per cent.

²⁴ See the Reserve Bank share market data (which includes dividend yield) at <http://www.rba.gov.au/Statistics/Bulletin/F07.pdf> and Oliver (2009).

grow explosively). Historically, most variation in price/dividend ratios comes from varying expected returns, reflecting a changing risk premium.²⁵

That is, the risk premium changes over time and returns are predictable. If price/dividend ratio forecasts of dividend growth are not sufficient to explain the variance of price/dividend ratios, then the price/dividend forecasts of returns must fill the gap. Return predictability turns out to be exactly the same as excess price volatility (relative to constant discount rate present-value models). If share prices are 'too high', so that the price/dividend ratio is high, subsequent returns will be low as prices adjust to their correct levels. A high price/dividend ratio implies either investors expect dividends to rise in the future or expect returns to be low or expect prices to rise forever (a bubble).²⁶

It is controversial whether the residual discount rate movement is variation in real investment opportunities or represents 'irrational' behaviour and market inefficiency. Volatility tests are only tests of discount rate models, and are not tests of market efficiency. In fact, some discount rate process can rationalise any forecastability of returns (or price volatility). The issue is whether macroeconomic events, which change investment opportunities, justify the implied time variation in discount rates. Those who think excess volatility is evidence of market inefficiency must believe the expected returns on assets vary too much over time.²⁷

As the implied variation in discount rates gives rise to small utility costs, corresponds to reasonable measures of time varying investment opportunities, and appear related to business cycles, the evidence is at least consistent with efficient markets.

Reasons why the evidence suggests imperfections in the current discount rate models, rather than irrationality, include that the discount rate errors are small and are strongly suggestive of economic explanation. With a constant dividend growth g and discount rate r , $P/D = 1/(r-g)$. A small change in the discount rate has a large effect on price. For example, if $r-g$ changes from 5 per cent to 3 per cent, price rises by 66 per cent. This overstates the effect of changes in expected returns on price because expected returns are not constant, but they are stable enough for small market imperfections in expected returns to translate into a large effect on price. Large differences between the prices of similar assets are consistent with small differences in expected returns.

²⁵ Cochrane (2005, pp. 396-97).

²⁶ See Cochrane (2005, pp. 396-409).

²⁷ See Cochrane (1991).

Return predictability may suggest ‘second-order corrections to a basically correct efficient-markets view, such as better measures of fundamental movements in discount rates or incorporation of frictions like taxes, transactions costs and market microstructure’²⁸ rather than irrational investor behaviour. The financial economics literature interprets return predictability as efficiently reflecting time variation in risk premiums, induced by time variation in real investment opportunities available in the real economy. Time variation in discount rates appear to be related to business cycles. For example, risk premiums rise during recessions.²⁹

G.3 The marginal return to capital

The share market returns set out in table 2.2 are before-personal income tax (except for imputation credits) and after company tax and measure the return to levered equity. Working out the before-tax return to investment from share market returns is difficult and requires accounting for the effects of company tax and gearing levels.³⁰ Even then it is only the return to listed companies.

The marginal return to private capital is a weighted average of the returns in the various sectors, with the weights depending on the responsiveness of investment in each sector to changes in the interest rate.³¹ The best way to estimate the overall social yield of capital is to derive a direct measure of the real return to capital from the national accounts by dividing the total income from capital generated in the private sector by an estimate of the private sector capital stock.³² The average return to investors over a long time period should provide a reasonable estimate of the return to capital.

Hall and Scobie (2005) find the annual return to capital from 1978 to 2002 consistently exceeds 11 per cent real.³³ Mohun finds the real return to capital fell from a peak of 16.2 per cent in 1969 to a trough of 6.5 per cent in 1983, and then recovered to reach 13.4 per cent by 2001.³⁴ Makin (2006) finds the real net

²⁸ Cochrane (1991, pp. 463-64).

²⁹ Cochrane (undated; 2005, pp. 410, 442; 1991, pp. 478-82). He suggests other reasons for rejecting the irrationality view.

³⁰ See New Zealand Treasury (2008) for an example of the adjustments that need to be made.

³¹ See Harberger (1969) for details.

³² As suggested by Harberger (1987, pp. 177-78; 1992, p. 29) and by Poterba (1997, p. 10–1).

³³ See Hall and Scobie (2005, figure 14, p. 18). It is operating surplus divided by the net capital stock. It is not clear whether the operating surplus is net or gross, so they could be gross returns.

³⁴ These are net returns, GDP less wages, depreciation, and imputations divided by the capital stock. See Mohun (2004, pp. 104-09).

marginal return to capital to be in the range 8.2 per cent to 9.2 per cent from 1995-96 to 2004-05, averaging 8.8 per cent with a standard deviation of 0.3 per cent.³⁵ In 1997 the ABS produced estimates of the net return to capital from 1983-84 to 1995-96. They range from 15.3 to 18.5 per cent, averaging 16.8 per cent (with a standard deviation of 1.1 per cent).³⁶

Some studies of international returns to capital estimate the returns in Australia. Pyo and Nam (1999) find the real return to capital in Australia averaged 10.2 per cent from 1970 to 1995. Caselli and Feyrer (2007) estimate the return in Australia in 1996. Their estimates vary from 7 to 13 per cent real (they prefer 8 per cent).³⁷

This is consistent with the US evidence. The real pre-tax return on U.S. non-financial corporations over the last four decades has averaged about 6.6 per cent per year, while the returns to U.S. non-financial industries over the 1997-2006 period averaged 8.9 per cent per year.³⁸

Poterba (1997) finds over the 1959 to 1996 period, the real pre-tax return on capital in the non-financial corporate sector averaged 8.5 per cent. He estimates corporate capital income (net of depreciation) divided by a measure of the corporate capital stock. They follow a similar pattern to Dolman's estimates (falling from the mid-1960s to the 1980s, before recovering in the 1990s).

He also looks at the return to capital (business assets) in G7 nations from 1965 to 1996. They follow the same pattern and the average for all G7 was 14.3 per cent, slightly less than the US average of 15.4 per cent (these are gross figures).

Summers (1990) finds the national accounts estimate of the average return in the non-financial corporate sector from 1952-1987 to be 9.6 per cent, and 7.4 per cent for the private sector as a whole. His measure of the capital stock includes land and inventories. After accounting for various biases, Summers concludes the return to capital is in the order of 7 per cent. He too finds a fall from the mid-1960s to the 1980s.³⁹

³⁵ See Makin (2006, table 1, p. 230).

³⁶ See Australian Bureau of Statistics (1997, table 26, p. 55). The estimates are the ratio of net operating surplus to the net capital stock. The capital stock is non-dwelling construction and equipment. It is not clear whether these are real or nominal rates of return.

³⁷ All these estimates appear to be gross returns (before depreciation), but do not include any capital gains from changes in capital good prices. For example, without any relative price changes, the value of the capital stock would be expected to increase at the rate of inflation.

³⁸ Nordhaus (2007, pp. 689-90).

³⁹ See Summers (1990, pp. 118-120).

Mulligan (2003) estimates the capital income net of depreciation per dollar of capital in place at the beginning of the year. Capital is fixed assets valued at current cost, and is aggregated for private residential and non-residential sectors. The capital measured is employed domestically (including foreign-owned capital), includes owner-occupied housing, excludes consumer durables, and excludes the government sector. The capital income measure is before all taxes and ignores capital gains (other than the effects of depreciation). From 1947-96 the average real before-tax rental rate, net of depreciation averaged 9.5 per cent, varying from 7.3 to 12.1 per cent with a standard deviation of 1.1 per cent.⁴⁰ In Mulligan (2002) he estimates the pre-direct-tax capital rental measure from 1900 to 1996. It ranges from 3.7 to 12.5 percent. Mulligan then establishes that his estimated after-tax marginal return to capital is a much better predictor of consumption growth than interest rates on financial assets.

All the national accounts based estimates have a number of biases. For example, income of unincorporated enterprises needs to be divided into income accruing to labour and income accruing to capital.

Estimates of capital income often include income accruing to land, whereas the estimates of the capital stock (usually derived using the perpetual inventory method from investment flows) usually exclude land. For example, Caselli and Feyrer (2007) find that accounting for land and other natural resources reduces their estimated marginal product of capital in Australia from 13 per cent to 7 or 8 per cent.⁴¹

On the other hand, estimates of capital income usually exclude indirect taxes and property taxes. Harberger suggests the social yield on capital investment is the private return (profits, interest and rent) and the taxes paid on it – including:

property taxes on the land, building and other assets used in the process of production; capital's share of value added taxes paid on the value added of the entity (enterprise, industry, sector, total private sector) in question; capital's share of other indirect taxes paid as consequence of transforming raw materials and purchased components into the final products of the enterprise.⁴²

Poterba (1997) adds in property taxes to calculate the before-tax return. The property tax adjustment raises returns a full percentage point.⁴³ The Mulligan (2003) estimates also add property taxes.

⁴⁰ Mulligan (2003, p. 26).

⁴¹ See Caselli and Feyrer (2007, table II, p. 549).

⁴² See Harberger (1992, appendix 1).

⁴³ See Poterba (1997, p. 8–9).

The rate of return is calculated on the basis of those fixed assets that are measured in the national accounts, but if there are other, unmeasured assets that provide capital services, the measured rate of return on capital overstates the true return. For example, there are good reasons to argue that at least part of capital income comes from intangible assets. On the other hand, investment in intangible capital is currently measured as expenditure on intermediate inputs, reducing gross operating surplus. The net bias in the measured rate of return is not clear, and depends on the size of the measured return relative to the accumulation rate of intangible capital.⁴⁴ Further, although intangible assets have become more important over time, there is no upwards trend in the measured return to capital. Rates of return over the past decade are comparable with the returns in the 1960s.

An alternative way to proceed is to estimate the before-tax cost of capital to companies, which would equal the marginal return to investment in equilibrium. The cost of capital is the minimum rate of return that an investment project must earn in order to cover its funding costs and any tax liabilities. Although the supply of funding depends on expected returns, the cost of capital is usually estimated as a weighted average of realised debt and equity returns. Working out the before-tax return to investment from share market and debt returns is difficult. Gearing levels, dividend policy and effective tax rates are crucial, yet are difficult to measure, change over time, may change with changes in expected inflation and may interact with each other. Real world complications, such as incomplete loss offset and expected inflation varying over time, make the effects of taxes difficult to model and hard to measure.

Observed share-market returns (presented in section G.3) are after company and property taxes. Using financial market data to estimate the before-tax return is difficult. It requires accounting for the complicated effects of company tax, which depends on its interaction with inflation (e.g. through historical cost depreciation provisions and the deductibility of nominal interest payments), with personal taxes (which was affected by the introduction of imputation) and the effects of international capital flows (and their tax treatment).⁴⁵ Even then we have only measured the return to listed companies. Further, rates of return in financial markets are extremely volatile and subject to swings in expectations. Further, mistaken

⁴⁴ Let the earnings on capital be E , investment in intangibles X , the measured capital stock K and the intangible capital stock I . The measured rate of return on capital is $(E - X)/K$, whereas the true return is $E/(K + I)$. The measured return overstates the true return when:

$$(E - X)/K > E/(K + I) \text{ or } (E - X)(K + I) > KE \text{ or } EI - XK - XI > 0 \text{ which can be written as}$$

$$(E - X)/K > X/I \text{ or as } E/(K + I) > X/I. \text{ That is, only if the rate of accumulation of intangible capital is less than the return on capital.}$$

⁴⁵ See, for example, Cohen et al. (1999) on the effects of inflation on the cost of capital.

expectations can give negative realised real returns for long time periods. High volatility makes it difficult to pin down an estimate. For example, the standard deviation of realised annual share market returns is around 20 per cent, giving a 95 per cent confidence interval of plus or minus 4 percentage points even with 100 years of data. The standard deviation of national accounts based measures is usually around 1 per cent. National accounts measures are broader, steadier and more reliable. Moreover, Mulligan (2002) finds that the return on capital is correlated with growth but financial market returns are not.⁴⁶

But estimates of the cost of capital in Australia have been made, and they are consistent with the returns estimated from the national accounts. Lally (2000) found the consensus cost of capital for Australia to be 10 per cent real. Dews et al (1992) estimate the annual real pre-tax cost of capital from 1963-64 to 1983-84. The estimates fluctuate widely over time and also vary greatly depending on the weighting assumed for debt and equity (whether the weights are average or marginal shares or use stock or flow data). But the preferred measure is above 10 percent except in the mid-1970s.⁴⁷ The authors also survey previous studies, which have produced a wide range of estimates using various methodologies. The average cost of capital estimated varied from 18 per cent (Brunker 1984), 4 per cent from 1962-1986 and 8 per cent (1975-1986) (Carmichael and Stebbing 1981; Dews 1988; 1989), 10 per cent (Australian Manufacturing Council 1990), 11 per cent (long-run ex post) (Johnston, Parkinson and McCray 1984), 12 per cent ex ante using data from 1976-77 to 1985-86 (Department of Finance 1987), 6 per cent (ex-post) from 1967-68 to 1982-83 (Swan 1988).⁴⁸ The authors warn 'This paper demonstrates that a wide range of outcomes can result from often arbitrary assumptions used in constructing measures of the cost of funds.'⁴⁹ Other estimates range from 4.5 per cent (in 1999) to 10 per cent nominal (in 1998) to 10 to 11 per cent real.⁵⁰

Rough calculations confirm that the cost of capital estimated from share market returns are consistent with the national accounts estimates.⁵¹ Expressing the rates of return as continuously compounded, the before-tax real rate of return $i = \rho - \pi$ where ρ is the nominal return and π the expected rate of inflation. If the company tax rate is τ then $\rho = [(i_f + \pi)(1 - \tau) + \beta e] / (1 - \tau_e)$ where i_f is the risk free real rate of return, β is

⁴⁶ Harberger (1998, pp. 24-26) finds a positive relationship between the return to capital and rates of total factor productivity improvement.

⁴⁷ See Dews et al. (1992, p. 180).

⁴⁸ See Dews et al. (1992, appendix 1, pp. 24-26) for details.

⁴⁹ Dews et al. (1992, p. i).

⁵⁰ Bureau of Transport Economics (1999, p. 67), Commonwealth Competitive Neutrality Complaints Office (1998, pp. 9-11), and Department of Finance (1991, p. 57).

⁵¹ These calculations are based in New Zealand Treasury (2008).

the asset beta, e is the equity risk premium and τ_e is the effective rate of company tax. Nominal returns are taxed at the rate τ_e and the interest paid on bonds is tax deductible at the statutory rate. The effective rate of taxation may differ from the statutory rate. For example, because depreciation provisions that differ from economic depreciation. The effective rate would be higher than the statutory rate when only the historical or original cost of a capital asset may be written off even if the cost of replacing the asset is rising over time. Provisions such as accelerated depreciation would lower it. Further, inability to deduct losses would raise the effective rate further. For simplicity, I assume that $\tau = \tau_e$ and so $i = i_f + \beta e / (1 - \tau)$. Table G.3 shows how the before-tax real rate of return varies with the market risk premium and risk free rate of return, assuming a company tax rate of 30 per cent and an asset beta of 0.67. The market beta is one, which gives an average asset beta of 0.67 if the average level of gearing is 33 per cent.⁵²

Table G.3 The before-tax real rate of return

With a company tax rate of 30 per cent and asset beta of 0.67

<i>Market risk premium (e)</i>	<i>Risk free rate of return (r_f)</i>	
	<i>3 per cent</i>	<i>4 per cent</i>
3 per cent	5.9%	6.9%
4 per cent	6.8%	7.8%
6 per cent	8.7%	9.7%

The results are close to the national account measures of the marginal return to capital, which average 8.9 per cent since 1965. The numbers are indicative only, and are presented just to demonstrate that a before-tax real return of around 9 per cent is reasonable.

Further, Poterba (1997) finds the weighted average of equity and bond returns to be (on average) close to the average after-corporate tax national accounts return (for the US from 1959 to 1996), suggesting the before-tax national accounts returns are accurate. Summers (1990) also finds the two types of estimates to be consistent.

All the variables that determine the cost of capital vary over time. For example, the company tax rate was greater than 30 per cent for most of that time and imputation was not introduced until 1986. If the realised return to capital varies with the cost of

⁵² The gearing ratio is $g = D/(D+E)$ where D is the amount of debt and E the value of equity. But $g/(1-g) = D/E$ and so a gearing ratio of 33 per cent corresponds to a debt-equity ratio of 0.5. In 2007, the debt-equity ratio for the Australian share market was 0.37 (Jones (2008, p. 208), but the value of equity has fallen substantially since then. The relationship between market beta β_M and asset beta β_a is $\beta_M = \beta_a(1+D/E)$. See New Zealand Treasury (2008, p. 4-5). The lower the debt-equity ratio, the higher the asset beta (the closer to 1).

capital, then the historical average depends on the historical pattern of the risk free rate, gearing ratio, market risk premium and company tax rate.

An alternative approach would be to forecast the likely future cost of capital by estimating the future values of the variables that determine it. But that is difficult, all the more so if we took account of real world complications such as the effect of capital gains taxes. How to do so is often controversial.⁵³ A pragmatic approach is to use historical averages over long time periods as an indicator of the future. A disadvantage is that it encourages assuming that the cost of capital is constant. Explicitly estimating the future cost of capital (if possible) can account for predictable changes in the risk premium. In fact, if credit market conditions are temporarily unusual (or likely to change), it is desirable to explicitly allow the discount rate to change over time, towards its normal (or predicted) level.

G.4 The effect of tax on the risk premium

The risk premium is a substantial portion of the market return. It would appear that taxation of risky returns would mean a smaller after-tax premium. For example, if the before-tax market rate of return was 8 per cent and the risk-free rate 4 per cent, the risk premium is 4 per cent. With a 50 per cent tax rate, the after-tax market rate of return is 4 per cent and the after-tax risk free rate is 2 per cent, the after-tax risk premium is 2 per cent. The tax reduces the risk premium proportionately.

But with proportional taxation and full loss offset, the after-tax price of per unit of risk is the same as the before-tax price. Although part of the risk premium is taxed, the variance of the asset is reduced proportionately. These two offset, leaving the ratio of reward to risk (the Sharpe ratio) unchanged.

A tax on the whole real return is equivalent to taxing only the riskless part of the return for market traded assets. The appropriate risk premium is unaffected. The pre-tax risk premium should be used to judge the risk coming from the government project, it is the social price of risk.

To see this, consider a world where only the riskless return, r is taxed at rate t . An investor invests X in a risky asset that pays a gross return R_i in state of the world i . After the risk is realised and tax is paid on the riskless return, a tax payment of trX , the gross after-tax return in state i is $R_i - trX$.

⁵³ For example, the standard approach is to account for the burden capital gains taxes impose on the cost of equity with the accrual equivalent tax rate of capital gains (as done, for example, by Cohen etc al. (1999, p. 205). Jones (2009) argues this is incorrect because personal taxes are only paid when capital gains are realised and not when they accrue.

Now assume instead the tax (at rate t) is imposed on all investment returns, including the risky component, and there is full deductibility of losses. If the consumer increases his investment in the risky asset from X to $X/(1-t)$, borrowing the additional funds at the riskless rate r , then in state i the investor will receive (after paying tax and repaying the loan):

$$\begin{aligned} \frac{R_i}{1-t} - \frac{tX}{1-t}(1+r) - t \left[\frac{R_i - X}{1-t} - \frac{tX}{1-t}r \right] &= (1-t) \frac{R_i}{1-t} - \frac{tX}{1-t}(1+r-1-tr) \\ &= R_i - \frac{tX}{(1-t)}r(1-t) = R_i - trX \end{aligned}$$

The first term is the gross return on the investment of $X/(1-t)$, the second term is the repayment of the loan $tX/(1-t)$ with interest (or the forgone income from reducing investment in the risk free asset), and the third term is the tax owed (including the deduction allowed for interest payments on the loan).

The investor receives the same after-tax return when all returns are taxed as when only the riskless return is taxed for every possible outcome (for every state of nature). The same result would apply if the investor funded the increased investment in the risky asset by reduced investment in the risk free asset rather than by borrowing. It would apply if nominal interest payments were taxed.

Taxes on the risky component of returns have no effect on individuals, who simply gross up their investments in risky assets to offset the effects of the tax. Portfolio adjustments mean the taxation system only taxes the riskless part of the return and not the risk premium. A tax on all returns is equivalent to a tax only on the riskless return.

Taxing risky returns does not, in the end, provide insurance since taxpayers' portfolio adjustments unwind this effect of taxation. Taxpayers wanting less risk could have invested in less risky portfolios in the absence of taxation; if subject to a system that automatically absorbs a portion of any risk they take, they simply gross up the extent of their pre-tax risk exposure in an offsetting manner.⁵⁴

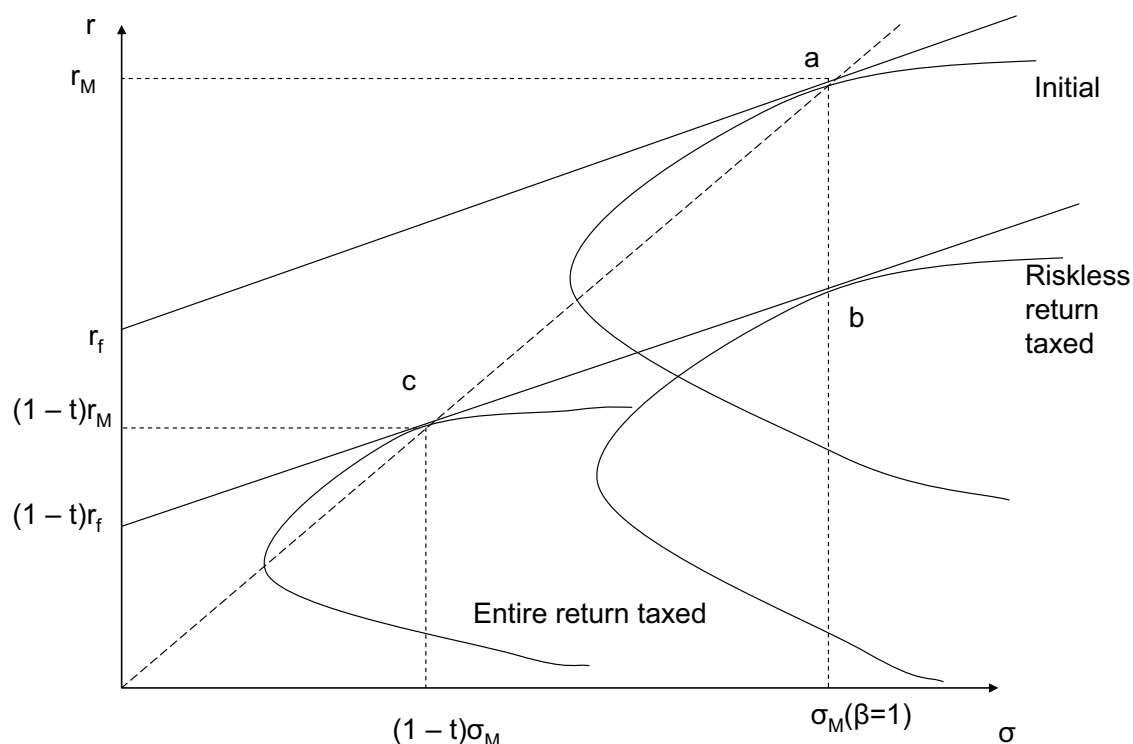
Figure 6 illustrates the effects of taxation with the standard capital market diagram, which shows the portfolio frontier and capital market line. The slope of the capital market line, $\frac{r^M - r^f}{\sigma_M}$, is the Sharpe ratio. A tax on the risk free part of the return shifts the portfolio frontier and capital market line down in a parallel fashion. A tax on all returns shrinks in the portfolio frontier (reducing variance and average returns

⁵⁴ This proof and explanation is from Kaplow (2008, pp. 239-241).

by a proportion t) and gives the same capital market line, and so the same opportunities.

This is a first approximation, and is true for proportional taxation of the real return with full loss offset when the investor can borrow and lend at the risk-free rate. In reality marginal rate progression, certain restrictions on the use of tax losses, limits on the ability to gross up certain types of investments and borrowing constraints will affect the risk premium. Borrowing constraints are not obviously important for those holding most assets, assets obtained when grossing up might themselves be used as collateral and constrained individuals can purchase assets with greater risk rather than personally borrowing to buy more assets of a given risk. But the lack of full loss offset would raise the effective rate of taxation on risky assets. Grossing up is difficult for untraded and illiquid assets. Forced diversification through the tax system would be inefficient if the imperfection that caused the illiquidity was moral hazard. It may be efficient if adverse selection restricted liquidity.⁵⁵

Figure G.1 Taxing all returns is equivalent to taxing the risk free return



⁵⁵ Kaplow (2008, p. 241, footnote 35).