Choosing the Social Discount Rate for Australia

Peter Abelson and Tim Dalton*

* Abelson: Department of Economics, Macquarie University, New South Wales 2109 Australia, and Applied Economics Pty Ltd, New South Wales 2000 Australia; Dalton: Applied Economics Pty Ltd, New South Wales 2000 Australia. Corresponding author: Abelson, email <pabelson@appliedeconomics.com.au>. We thank two referees for their helpful suggestions. We are of course responsible for the article.

Abstract

This article argues that in cost–benefit analysis government should adopt the opportunity cost of capital as represented by the alternative project rate of return as the social discount rate rather than the private or social time discount rate or a weighted cost of funds rate that reflects estimated proportions of investment and consumption foregone. The appropriate metric for the alternative project rate of return is average market return allowing for non-diversifiable risk but not for diversifiable project risk. The article concludes that the appropriate social discount rate for Australia, for all sectors and states and territories, is approximately 6.5 per cent.

1. Introduction

Determining an appropriate real social discount rate (SDR) to apply to future costs and benefits for public projects is one of the most controversial and important issues in cost–benefit analysis.[1] From a political perspective this is not surprising, as the choice of SDR has a major impact on the acceptance or refusal of many public projects. Thus, there are numerous calls for the application of lower discount rates, especially, though not only, for long-lived projects and policies. It is perhaps more surprising that, after decades of argument, academics have not reached a consensus on the preferred SDR, the treatment of risk and how best to estimate an opportunity cost discount rate.

In this article, we first outline the main SDR options, including the opportunity cost of capital as represented by the alternative project rate of return, the private and social time preference discount rates and a weighted cost of funds SDR rate that reflects the estimated proportions of investment and consumption foregone. In Section 3 we give reasons for preferring the alternative project rate of return SDR. Section 4 discusses the critical issue of treatment of risk. Sections 5 and 6 discuss methods for estimating the preferred alternative project rate of return SDR and actual values for Australia respectively. In Section 7 we discuss briefly whether this SDR should change over time. Section 8 concludes.

2. Alternative Social Discount Rates

There are four major, distinct, SDR concepts:

(i) the private time preference rate (PTPR), the rate at which individuals are willing to forego marginal consumption now for increased marginal consumption in the future;

(ii) the social time preference rate (STPR) is the 'value that society places on present consumption relative to future consumption' (Black, Hashimzade and Myles 2013);

(iii) the opportunity cost of capital (OCC) as reflected in the rate of return on the best alternative project (the Alternative Project Rate of Return, or APRR);

(iv) a weighted cost of funds discount rate, with the weights reflecting how much project expenditure displaces current consumption (for the weight on the PTPR or STPR) and investment (for the weight on the OCC).

We briefly discuss each of these in turn, as well as a related shadow price of capital approach, which is another way to combine use of an opportunity cost of capital with a time preference rate.

2.1 The Private Time Preference Rate

The PTPR can be inferred from observations of market interest rates adjusted for inflation and tax as follows. Suppose, for example, that the nominal risk-free interest rate (*nr*) for *saving* is 5 per cent, the marginal tax rate (*t*) is 30 per cent and the expected inflation rate (π) is 2 per cent. The PTPR would be:

$$PTPR = \frac{1 + nr(1-t)}{1 + \pi} - 1 = \frac{1 + (0.05 \times 0.7)}{1.02} - 1 = 1.5\% \qquad (1)$$

A PTPR of 1.5 per cent means that individuals place equal value on $100 of marginal consumption this year and the prospect of $101.50 of marginal consumption next year. The PTPR may reflect a number of underlying factors, including pure time preference, diminishing marginal utility and precautionary saving.

Current nominal market interest rates on savings of around 2–3 per cent imply a near-zero private time preference rate. [2] On the other hand, many individuals borrow at double digit interest rates, for example on credit cards, to finance marginal current consumption and receive no tax concession on this. After allowing for inflation, the implied short-term time preference rate for these individuals may be as high as 8–9 per cent! This reflects a very high, short-term, time preference rate and may reflect impatience (pure time preference), liquidity constraints or both.

2.2 The Social Time Preference Rate

The STPR attempts to place weights on marginal consumption to maximise the welfare of any given society over time. Following Ramsey (1928), social welfare is maximised by a discount rate that equalises the marginal utility of consumption (or income) at each point in time. The STPR often includes a pure time preference rate as well.

Thus, the STPR is represented generally by:

$$STPR = \theta + (g \times \eta) \qquad (2)$$

where θ is pure time preference, g is the expected growth in per capita consumption and η is the elasticity of the negative marginal utility of consumption, that is, the percentage decrease in marginal utility from a 1 per cent increase in consumption.[3]

Estimates for both g and η are typically between 1.0 and 2.0 for developed economies (see Harrison 2010, Table 3.1). This implies a mean value for $(g \times \eta)$ of 2.25 (equal to 1.5 × *1.5)* with an extreme range for $(g \times \eta)$ from 1.0 to 4.0. Pure social time preference allows for an add-on catastrophe (existence) risk or precaution against possible elimination of project returns through destruction of capital and technological obsolescence. HM Treasury (2011) proposed that θ has a value of 1.5. On the other hand, Stern (2006) argued that θ should be 0.1 and Ramsey (1928) suggested 0.0.

Thus, the UK Government uses a discount rate of 3.5 per cent based on the STPR with g=2.0 per cent, η=1.0, and θ = 1.5 per cent (HM Treasury 2011). Similarly, Moore, Boardman and Vining (2013a) recommend a discount rate of 3.5 per cent for the United States, based on their calculation of the STPR (rounded from 3.56 per cent) with g = 1.9 per cent, η = 1.35 and θ = 1 per cent.

2.3 The Alternative Project Rate of Return

The alternative project rate of return (APRR) is the marginal *gross* rate of return that can be achieved by an alternative investment in the public or private sector. Given difficulties in estimating marginal returns in the public sector, the APRR is often measured by the average market return on private investments, including a premium for non-diversifiable risk, but not project risk.

Even before any additional return for non-diversifiable risk, the APRR is generally higher than PTPR because it is measured *before tax* to include that portion of an investment's return that is captured by the government as tax revenue, whereas the PTPR is measured after tax. Using the same interest rate and inflation numbers as before, and ignoring transaction margins, the risk-free APRR would be 2.9 per cent.

$$\text{APRR} = \frac{1+nr}{1+\pi} - 1 = \frac{1.05}{1.02} - 1 = 2.9\% \qquad (3)$$

At current nominal market interest rates of around 2–3 per cent, equation (3) would give a risk-free real APRR of around 0–1 per cent. However, allowing for non-diversifiable market risk, the average risk-inclusive APRR is generally some 6 percentage points higher in real terms than the risk-free APRR (depending on the methodology and assumptions applied—see Subsection 6.2).

2.4 A Weighted Cost of Funds Discount Rate

The weighted cost of funds (WCOF) approach may be represented by:

$$WCOF = (w \times PTPR) + (1-w)\,(APRR) \qquad (4)$$

where *w* is the proportion of capital employed in the project that reflects foregone consumption and (1–*w*) is the proportion that reflects investment foregone. In some versions of the *WCOF*, the cost of foreign capital is included as in equation (5).

$$WCOF = (w \times PTPR) + (1-w-f)\,(APRR) + fMC_f \qquad (5)$$

where *f* is the proportion of investment that is funded by foreign capital and MC_f.is the marginal cost of foreign capital.

The proportion of each 'source' of funds is intended to reflect the amount of consumption and investment displaced (or foreign capital borrowed) to fund the project. This will depend on various factors including how consumers and investors respond to marginal changes in interest rates. It is not simply a question of the (immediate) source of the funds employed in a particular project.

2.5 The Shadow Price of Capital Approach

The shadow price of capital approach should be mentioned because it accounts fully both for the displacement of other investment and for consumption to be discounted at a time preference rate. Thus, it provides a way to combine two discount rates and hence potentially to avoid a choice between them. Under this approach the foregone investment is converted into the stream of consumption foregone based on the rate of return on the alternative investment. This foregone consumption stream is then discounted at the relevant time preference rate to obtain a shadow price of capital for the proposed project. Finally, this shadow price is included as a cost in the stream of costs and benefits of the proposed project, which are discounted at a consumption (time preference) discount rate to calculate net present value.

This approach is technically attractive. However, there are practical complications. Like the WCOF approach, the shadow price of capital approach requires assumptions regarding the proportion of consumption and investment displaced. Also, assumptions are required about reinvestment, savings and depreciation in alternative investment(s).

Further, the shadow price of capital approach generally provides results that are consistent with the using WCOF or APRR approaches to discounting, depending on the assumptions about the source of funds or the alternative use of the funds respectively. For these reasons, the shadow price of capital approach is rarely employed.

3. The Preferred Form of Social Discount Rate

In this section, we provide reasons why the APRR, rather than a time preference rate or WCOF rate, should be the preferred SDR in the context of public investment appraisal.

3.1 APRR versus a Time Preference Rate

Differences between the OCC (as represented by the APRR) and time preference rates lie at the heart of the debate about SDRs. The key problem arises because, on the one hand, we seek to maximise social welfare over time. This implies use of individual (private) or social time preference rates that reflect how individuals or society values marginal consumption at different points in time. On the other hand, we want to do efficient projects, that is, projects that at least match the rate of return that can be obtained on marginal alternative projects. In perfect markets, the APRR would match the marginal PTPR. However, because of taxation and the treatment of risk, the APRR generally exceeds time preference rates, often by a significant amount. This sets up a major tension between alternative views of the appropriate discount rate to apply to public projects or policies.

In our view, there are strong reasons for adopting an OCC approach to setting the SDR rather than a time preference rate. Time preference rates are structurally lower than opportunity cost discount rates because they do not allow for pre-tax benefits and (typically) do not include a premium for risk. This does not necessarily disqualify time preference rates, but it means that we need to be sure that adopting a time preference discount rate would not create inefficient outcomes.

Critically, adopting a low, time preference, SDR encourages adoption of projects with low returns. If project B has a return of say 5 per cent and the alternative project A has a return of 7 per cent, the community receives lower benefits from project B than from the alternative A. This is an inefficient use of resources. Even if society places a high weight on the wellbeing of future generations, their wellbeing can be *increased* by investing and reinvesting in projects with the highest available rates of return. Providing there are sufficient reinvestment opportunities, future generations are less well-off if low return projects are adopted. In other words, if the time preference rate is 3.5 per cent, project B returning at 5 per cent would be better than no project at all, but it is inferior to an alternative that returns 7 per cent. Proceeding with project B would be appropriate only in the unlikely situation where there is no possibility of applying the funds in a sensible alternative investment.

Notwithstanding these arguments, it is sometimes contended (for example by Moore, Boardman and Vining 2013a, 2013b) that since most projects are funded ultimately by taxation and reflect consumption foregone, the consumption or time preference rate of discount is the most relevant SDR or at least the dominant element in a WCOF discount rate. Accordingly, they argue for a time preference approach, with shadow pricing of capital as necessary to reflect any displaced investment, which they consider negligible.

Essentially, this is a shadow price of capital approach along with a high weighting for displaced consumption. It is not an argument for simple application of a time preference discount rate as such. As noted above, under reasonable assumptions the shadow price of capital approach and WCOF approach are equivalent—the real debate is about the appropriate weight to be given to displaced consumption versus displaced investment. We discuss the WCOF method below.

In conclusion, in making any public investment, we want to choose the most efficient investment. It is inefficient to invest in projects with returns below the APRR.

3.2 APRR versus WCOF

Many experts advocate a WCOF (or shadow pricing) approach. These include Moore, Boardman and Vining (2013a, 2013b), Burgess and Zerbe (2011, 2013) and Harberger and Jenkins (2015). Their key point is that the APRR overstates the real cost of investment because part of the cost is foregone consumption, which has a lower real cost than foregone investment.

However, there is major disagreement on the extent to which government investment displaces other investment, domestic consumption or draws on foreign borrowings. For example, Moore, Boardman and Vining (2013a, pp. 10–11) contend that government investment primarily displaces consumption because government borrowing (as a percentage of GDP) cannot increase indefinitely and therefore increased government spending is funded mainly by increased taxes that primarily reduce current consumption rather than private investment. They also argue (p. 11) that, as government investment primarily displaces consumption not private investment, 'there is little need to shadow price private-sector investment [and] discounting becomes easy: analysts should simply discount using the rate of (social time preference rate) STP'. Moore, Boardman and Vining (2013b, p. 406) also argue that the most plausible view of the fiscal world 'is that the government sets an overall target for the government deficit and debt. Project evaluation then occurs against this background. On the margin, any new project will need to be tax-financed'.

On the other hand, Burgess and Zerbe (2011, 2013) and Harberger and Jenkins (2015) consider that government investment primarily displaces private investment, but may also displace some consumption and require some foreign capital. Thus, they prefer a WCOF approach with a high weighting on displaced investment. For example, Burgess and Zerbe (2013, pp. 395–6) argue that different government agencies set tax rates and approve project expenditures. They also argue that project expenditures are typically under-estimated and that government borrowing is the means for bridging the funding gap. On this view, public investment is funded by government borrowing at the margin, which removes funds from the capital markets, leads to higher interest rates and thereby crowds out private investment and (to a lesser extent) causes households to reduce consumption.

However, there are two significant objections to use of the WCOF. First, regardless of how funds are raised (that is, whether consumption or investment is displaced), looking forwards there is always an investment opportunity cost. This is the best alternative project to which government could apply the available funds. Secondly, where alternative projects would return the APRR, using a (lower) WCOF on the basis that a project could be financed by additional government borrowing implicitly assumes that government borrowing will be expanded to the point where all (higher returning) alternative projects are also funded (otherwise, any additional borrowing should be applied to those projects first). This could require a significant change to existing fiscal policy and, in our view, this is not a realistic assumption for individual cost–benefit analysts to make.

Employing the APRR is consistent with the view that overall fiscal policy, including government's borrowing target, is fixed independently of individual projects. This is supported by Spackman's (2013, p. 200) observation that '[a]ggregate levels of public capital spending are in any case almost entirely macroeconomic and political decisions'. This approach seems appropriate generally in Australia. The APRR approach is also consistent with *any* un-hypothecated increase in borrowing where government seeks the most efficient investment from the additional funding as measured by the net social benefit metric.

Our view that the APRR is the appropriate opportunity cost may imply that current aggregate fiscal policy is not optimal. If the APRR is higher than the WCOF, welfare may be enhanced by raising more government debt to fund more government investment. But in our view the issue of aggregate fiscal policy is outside the concern of the individual cost-benefit analyst. For individual project assessment, aggregate fiscal policy (inclusive of any borrowing target) should be taken as fixed and the next best use of available capital in the public or private sector is therefore the appropriate opportunity cost.

In much of the literature, the counterfactual of government borrowing or taxation (rather than an alternative investment) is based on an assumption that the government is unable to invest in the private sector for political or other reasons. Moore, Boardman and Vining (2013b, p. 405) refer to 'the Bradford-Lind-Arrow view (Arrow, 1995; Bradford, 1975; Lind, 1982) that, in a mixed economy, the government does not have the option to invest directly in the private sector'. However, the growth of sovereign wealth funds that invest directly in diversified portfolios of private sector investments would appear to demonstrate that private sector investment is feasible (see Harrison 2010, p. 51). Also, these authors generally recognised that if government investment in the private sector was feasible, then the APRR would be the correct discount rate. For example, Bradford (1975, p. 893) questions how it can make sense for government to invest in a project with a yield of 5 per cent when there are projects available in the private sector yielding 10 per cent. He answers that this can make sense only if the private sector investment is not also an investment opportunity for the government.

Of course, estimates of the WCOF that give a high weight to investment foregone provide an outcome close to the APRR. Harrison (2010) estimated that the real pre-tax marginal rate of return on private capital is 8.9 per cent, while the WCOF adjusted to reflect the impact of tax distortions and foreign borrowing reduces the rate of return by around 1 percentage point to around 8 per cent.

However, this is contingent on a particular view of the amount of investment and consumption displaced. In practice, there are many possible SDRs with the WCOF approach depending on the fiscal context.

In addition, the inclusion of a risk premium is less straightforward under the WCOF approach, because the risk premium in private investment markets is often argued to be higher than can be explained by the actual variability of equity returns—the so-called equity premium puzzle. Some argue that the true cost of risk to government is substantially less than the 6–7 per cent premium historically received by private stock market investors—for example, the Bureau of Transport and Regional Economics (2005, p. 11) suggests that, 'if we attempted to adjust the results of CBAs to take account of systematic risk, then the adjustment would be so small as to be trivial'. But as Harrison (2010, p. 50) notes, 'if the government can directly invest in the private sector, the return on private capital is the opportunity cost of investing in government projects, even if it reflects an irrationally high price of risk that the government has an advantage in dealing with'.

4. Treatment of Risk

There are essentially two issues in relation to risk. They are whether to allow for non-diversifiable (market) risk and/or for diversifiable project risk, and if so how? Non-diversifiable risk is the risk of an investment that cannot be reduced by adding that asset to a diversified investment portfolio. It is also known as general market risk and as systematic risk. Project risk is the risk associated specifically with the project that may be reduced by diversification.

4.1 Non-Diversifiable Market Risk

As noted above, the return on private capital is an important opportunity cost for investing in government projects. Given that public funds can be placed in a diversified investment in the capital markets, the return available on such investments is an appropriate proxy for the average risk opportunity cost of capital. The market rate of return for investments with an average market (non-diversifiable) risk is more measurable than a hypothetical return on an alternative public investment. This does not require a view that government is, or is not, risk averse.

As outlined below in Subsection 5.2, the expected return on private investments can be estimated using the capital asset pricing model (CAPM). Under the CAPM, the expected return includes a risk premium for unavoidable market risk such as economic recessions. Indeed, in the current environment of very low interest rates, this premium makes up most of the expected return. This is not a premium for project specific, diversifiable risk. Private investors (and governments) are assumed to pool and diversify away any risks that can be diversified. Investors demand (and receive) a premium only for projects with some non-diversifiable (market) risk.

The issue now arises whether the alternative under the APRR approach should be a capital investment *with a similar amount of non-diversifiable market risk* to the public project under consideration rather than a project with an average market (non-diversifiable) risk.

While government projects, like private ones, are subject to general market risks, it is sometimes argued that certain types of government projects should be viewed as involving higher or lower market risk than average private investments, for example, monopoly utilities in water or power transmission may have lower general market risk, and that this should be reflected in the SDRs applied to them. Harrison (2010, p. 60) suggests using a representative or average risk APRR as the default position, but to allow for this to be varied if there are clear arguments that a project has higher or lower than average market risk.

Varying the discount rate to reflect the degree of market (non-diversifiable) risk has some theoretical appeal. However, in our view, there are strong practical reasons for adopting a uniform APRR based on average market (non-diversifiable) risk. As Harberger and Jenkins (2015, p. 17) observed, the practical difficulty in estimating the market covariance of every public project 'utterly terrifies' even the most experienced practitioners, and 'it will be a long time before the profession will be widely implementing such a methodology'. For this reason, we favour adopting a strong presumption of a uniform discount rate based on average market (non-diversifiable) risk, but like Harrison (2010) would allow for exceptions to be made where this would lead to perverse outcomes or where there is overwhelming evidence that a higher or lower discount rate is appropriate.

One such exception occurs when private parties bear part or all the risk of a public project as may occur for partly or wholly privately financed projects. The discount rate should then reflect the rate at which the private parties are willing to bear risk and part with their capital as this represents their perceived cost, ability to diversify and required rate of compensation. For example, for assessment of public–private partnership proposals, Australian Government Department of Infrastructure and Regional Development's (2013) National PPP Guidelines recommend risk adjusted discount rates based on the CAPM. Indeed, for types of projects that are routinely undertaken and funded by the private sector, market benchmarks for the degree of non-diversifiable risk and the required rate of return should be available, meaning that there is a stronger argument for departing from the assumption of a uniform discount rate based on average risk. In such cases, applying an inflexible and uniform discount rate would create a bias in favour of government funding of high risk projects, and private sector funding of low risk projects (Australian Government Department of Infrastructure and Regional Development, p. 67).

4.2 Diversifiable Project-Specific Risk

It is sometimes argued that an additional risk premium should be required for particularly risky projects, even if that risk is diversifiable. This may arise, for example, in projects with highly uncertain construction cost or demand estimates. Although this is sometimes observed in private sector practice, there are three reasons for not adopting such a rate for public projects.

First, following Arrow and Lind (1970), when governments can pool risks by project diversification or spread risk over a large number of taxpayers, government achieves the best outcome for the community by selecting projects on the basis of their expected value with a standard SDR and not discriminating against projects with high expected value but increased risk. This is consistent with the CAPM, which includes no premium for diversifiable risk.

Second, there are better ways to analyse and describe project specific risks. Adding a project specific risk premium to the discount rate alters costs and benefits as a function of time, not of risk, and therefore may distort the outcomes. Only when time and risk are perfectly correlated would this be correct. A higher discount rate reduces the present value of the most distant benefits, not the most risky ones. For example, a change in the discount rate to deal with risks associated with up front construction costs will have very little impact on the present value of those costs, but a large impact on the value distant benefits, even if those benefits are relatively low risk.

Third, there is no agreed or objective way by which risk adjustment can be made via a discount rate. One party might think that a small increase in the discount rate would be required whereas another party would consider a higher increase appropriate. There would be no consistency in the evaluation and treatment of projects. Any optimism bias in project estimates should be corrected for explicitly, rather than through the addition of an arbitrary risk premium in the discount rate.

5. Estimation Methods

The principal practical methods of estimating the rate of return of alternative capital investment are based on returns in the private sector as there are generally no ready metrics on returns on alternative public projects. An assumption in drawing on private returns is that there are no major external costs and benefits that would cause the social return to be significantly different from the market return.

Estimating the alternative return from market data may be based on historical returns or on the expected returns implied by current financial market pricing. In addition, some measures may attempt to capture returns across the economy as a whole (such as historical national accounts data) while others are narrower, such as the weighted average cost of capital (WACC) of listed companies, for which more extensive data may be available.

5.1 Deriving the SDR from National Accounts

As described by Poterba (1997), estimates of average rates of return on private investment can be derived from national income accounts. A direct measure of the average real return to capital can be derived by dividing the total income from capital generated in the private sector by an estimate of the private sector capital stock. This average return to investors over a reasonably long period should provide a reasonable estimate of the return to capital.

Of course, this requires that estimates of both income from capital and of the capital stock are reasonably robust. As Harrison (2010, pp. 130–2) points out, there are several issues arising. First, land and natural resources are usually omitted from estimates of the capital stock. Accounting for land and natural resources reduces the return to capital. Second, income from unincorporated enterprises is allocated to capital and none to labour. This omission also leads to a possible over-estimation of the return to capital stock. Third, if there are other, unmeasured assets that provide capital services, the measured rate of return on capital overstates the true return. For example, part of capital income may arise from intangible assets. However, investment in intangible capital is generally measured as expenditure on intermediate inputs, which reduces gross operating surplus. On the other hand, in so far as indirect taxes including property taxes are excluded from estimates of income from capital, total income from capital may be underestimated in the national accounts.

5.2 *CAPM and WACC Based Measures*

Estimation of the APRR under this approach is generally based on the capital asset pricing model (CAPM), which describes the relationship between non-diversifiable market risk and required return in capital markets. The CAPM is typically used to estimate the required return on equity investments. On the other hand, because companies also use debt, the risk and return on the stock market (equity) is higher than the underlying risk and return of company operations. The weighted average cost of capital (WACC) is an alternative measure that reflects the average return on all sources of a company's financing—which is also the expected return on the company's underlying operations.

For example, Moore, Boardman and Vining (2013a) base their estimate on the WACC of private firms, which involves a weighted average cost of debt and equity. As they observe, a private firm will not invest unless the expected nominal rate of return exceeds the WACC. They use historical returns on debt and equity (rather than the CAPM) to estimate that the real marginal return on investment (ROI) was 6.79 per cent in the United States for the post-war period to 2011.

One advantage of the CAPM is that it can provide a forward-looking estimate of expected returns, at least in relation to the risk-free rate component. In the CAPM, the cost of equity capital (R_e) equals the risk-free borrowing rate (R_{rf}), which represents the time value of money, plus compensation for the non-diversifiable (market) risk of the asset:

$$R_e = R_{rf} + \beta_e.(R_m - R_{rf}) \qquad (5)$$

where R_m is the expected market return and β_e is the covariance of equity returns with market returns divided by the variance of market returns. The beta is a critical parameter as it determines the market risk associated with each project.

Including debt, the cost of capital is a weighted average of the cost of equity and cost of debt:

$$WACC = (1 - g).R_e + g.R_D \qquad (6)$$

where g is the ratio of debt to assets and R_D is the cost of debt. The equity component of this is typically estimated using the CAPM and the debt component from observed debt yields.

We conclude this review by recommending use of the CAPM / WACC measures, with national accounts measures as a cross check. The CAPM / WACC measures have fewer measurement issues than the national accounts measures. However, most estimates based on the national accounts have been relatively stable over time and may provide a reasonable proxy for expected future returns.

6. Estimation Results

We discuss below national accounts-based estimates of historical returns and forward-looking returns based on the CAPM, or more specifically an estimated WACC drawing on current data. We then briefly note some international comparisons.

6.1 Estimates Based on National Accounts

Drawing on Dolman's (2007) estimates derived from national accounts, Harrison (2010) estimated a real rate of return on capital in Australia of 8.9 per cent. Harrison (2010, p. 59) noted that the real rate of return in Australia 'has averaged 8.9 per cent over long time periods and is more stable than share market returns'. Harrison also observed (p. 38) that this is 'consistent with other national accounts-based estimates of the before-tax rate of return to investment in Australia and the United States and with estimates of the cost of capital in Australia'.

Other estimates of the real rate of return on capital based on national accounts data include:

- 8.6–10.8 per cent as a 'likely' range for advanced economies (Harberger and Jenkins 2015, p. 14);
- 8.5 per cent in the United States (Burgess and Zerbe 2011) based on Poterba's (1997) estimate for the US non-financial corporate sector over the period 1959–1996; and
- 11.5 per cent in Canada (Jenkins and Kuo 2007) based on data for 1966–2005.

However, there are two reasons to suspect that future returns may be lower than the historical average. First, Dolman's data (reproduced in Harrison 2010, p. 38) includes the period of very high returns in the early 2000s (11.7 per cent real), but the data ends in 2007. The average over a period that includes the global financial crisis and subsequent years of weaker economic growth would be likely to be lower. Indeed, the average during the 1990s was 7.7 per cent real and the average during the 1980s was 6.9 per cent real (Harrison 2010, p. 38). Second, today's risk-free rates of return are well below their average over this historical period. If future total returns continue to average 8.9 per cent real, this would represent a significant increase in the risk premium. While there is some evidence that risk premiums rise in periods of low risk-free rates, it is unlikely that any rise expansion in risk premiums will fully offset the decline in risk free rates.

6.2 Our Estimate Based on WACC Method and Current Data

To illustrate how WACC is estimated, we draw on a recent example of the approach taken by the Australian Energy Regulator (AER 2016) to determine the allowed rate of return for providers of regulated network services but apply applicable current national data. The AER (2016) determination is a thorough application of standard CAPM methodology. However, as discussed above, for general public investment we support a WACC based on average risk rather than a WACC for a regulated utility. Thus, in Table 1, we show our estimated Australian WACC range for an average risk project along with the AER figures.

The United Energy determination allowed for a 'nominal vanilla WACC' of 6.37 per cent (AER 2016, Attachment 3, Table 3.1). However, this 'nominal vanilla WACC' measure needs to be adjusted because this is a nominal post-tax measure and the APRR measure should be real and before-tax. Using the parameters derived by the AER, we calculate an equivalent pre-tax real WACC of 4.60 per cent as shown in Table 1.

However, given that regulated network services usually involve less than average market risk, this would be at the low end of the range of private returns available. In particular, the AER assumed an equity beta of 0.7, a cost of debt based on a BBB+ rating and 60 per cent gearing (debt / total capital). A typical project might have an equity beta equal to the market average (that is, 1.0) and would not be able to sustain both a BBB+ rating and a 60 per cent gearing ratio. Table 1, therefore, shows potential parameters for a more representative private investment (with an equity beta of 1.0, a debt premium of 2.5–3.5 per cent and lower gearing of 30–50 per cent). We also update the nominal risk-free rate to the current 10-year bond yield (2.80 per cent), and show a range around the central values for the market risk premium (6–7 per cent) the value of imputation credits (30–50 per cent) and expected inflation (2.25–2.75 per cent). Using these parameters, we calculate that an 'average risk' project might have a real pre-tax weighted average return of around 6.46 per cent with a range of possible estimates from 4.94 per cent to 8.14 per cent

Based on the range of estimates above, in our view 6–7 per cent would be an appropriate APRR, representing the marginal pre-tax return on capital in Australia.

Of the parameters required to calculate the CAPM cost of equity, the market risk premium is often the most difficult to estimate. The AER (2016, pp. 3–57), in reaching its point estimate of 6.5 per cent, adopted a typical approach of considering a variety of data sources and methodologies, including historical averages of realised premia from stock market returns, forward-looking dividend discount model-based estimates, and survey evidence. These estimates ranged from 4.8 per cent to 8.84 per cent.

Table 1 Real Pre-Tax Rate of Return (WACC)

			Regulated utility (AER, 2016)	Range of estimates for "average risk" project		
				Low	Mid	High
Nominal risk free rate	[a]	%	**2.94**	**2.80**	**2.80**	**2.80**
Market risk premium	[b]	%	**6.50**	**6.00**	**6.50**	**7.00**
Equity beta	[c]		**0.70**	**1.00**	**1.00**	**1.00**
Equity risk premium	[d] = [b] x [c]	%	*4.55*	*6.00*	*6.50*	*7.00*
Nominal post tax return on equity	[e] = [a] + [d]	%	*7.49*	*8.80*	*9.30*	*9.80*
Corporate tax rate	[f]	%	**30.00**	**30.00**	**30.00**	**30.00**
Value of imputation credits	[g]	%	**40.00**	**50.00**	**40.00**	**30.00**
Effective tax rate	[h] = [f] x (1-[g])	%	*18.00*	*15.00*	*18.00*	*21.00*
Nominal pre tax return on equity	[i] = [e] / (1-[h])	%	*9.13*	*10.35*	*11.34*	*12.41*
Debt risk premium	[j]	%	**2.68**	**2.50**	**3.00**	**3.50**
Nominal pre tax return on debt	[k] = [a] + [j]	%	*5.62*	*5.30*	*5.80*	*6.30*
Gearing	[l]	%	**60.00**	**50.00**	**40.00**	**30.00**
Nominal pre tax weighted average rate of return	[m] = ([l] x [k]) + (1-[l]) x [i]	%	*7.03*	*7.83*	*9.12*	*10.57*
Forecast inflation	[n]	%	**2.32**	**2.75**	**2.50**	**2.25**
Real pre tax weighted average rate of return	**[o] = (1+[m]) / (1+[n]) - 1**	**%**	*4.60*	*4.94*	*6.46*	*8.14*

Note: Bold figures are assumptions, italic figures are calculations. In the first column ("Regulated utility"), all assumptions are based on AER (2016). In the remaining columns, the assumption parameters are updated, modified to be relevant for the average risk project, and/or shown as a range of estimates.

If it is argued that alternative public projects have, on average, lower market risk (and lower returns) than the average private project, then Table 1 indicates that such lower risk projects (for example regulated utilities) have an expected pre-tax return of around 4.5 per cent real. However, as discussed above, we do not view this as typical and we do not advocate varying the SDR for conjectural differences in the betas in the CAPM equation.

With a central discount rate of 6.5 per cent real, a reasonable range for sensitivity testing would be 4.5–8.5 per cent real. This would cover the full range of reasonable estimates for the pre-tax WACC of an average risk project (derived in Table 1), thereby allowing for the inevitable uncertainty in estimation of the input parameters to the WACC calculation.

By way of comparison, Australia's sovereign wealth fund, the Future Fund (2017), has a return benchmark of CPI + 4–5 per cent over the long term, which presumably reflects the Australian Government's expectation of a reasonably achievable return on private investments with an acceptable risk tolerance (this benchmark had previously been CPI + 4.5–5.5 per cent and was reduced by the Future Fund Investment Mandate Direction 2017). This is a post-tax return and is to be achieved using both debt and equity investments. Depending on the mix of investments and tax rates, it would imply a pre-tax return of around 6–7 per cent in real terms. On the other hand, many of the Future Fund's investments are international, meaning that tax payments are not recovered by the Australian Government, in which case the post-tax return is the correct opportunity cost.

6.3 Range of Discount Rates for Sensitivity Testing

The low end of 4.5 per cent real would represent the lower bound of estimates of feasible returns on alternative investment projects. It would also align with the Future Fund's benchmark post-tax return of CPI + 4–5 per cent. If the government can invest and reinvest with an expected real return of at least 4–5 per cent and a tolerable amount of risk, then it cannot be efficient to undertake any project with a return of less than 4–5 per cent real. This is a true lower bound for the expected social return on capital invested by the Future Fund because it is based on a post-tax return and makes no allowance for tax receipts on the Fund's domestic Australian investments.

While we do not support the use of risk adjusted discount rates, the sensitivity test at 4.5 per cent real could also be thought of as allowing for a reduced risk premium (based on arguments that the project has a lower than average cost of non-diversifiable risk). It is also low enough to allow for a substantial weighting on displaced consumption (based on arguments that if the project is not selected, the alternative may not be another investment but instead a tax cut, debt reduction or another spending program that leads to more current consumption).

The high end of 8.5 per cent real would represent the higher bound of estimates of feasible returns on alternative investment projects. It would also align with the higher national accounts based measures of returns on average investments (including areas of the economy not covered by public debt and equity markets). While the historical estimates in some of the studies noted above are as high as 11–12 per cent, current indications, including real bond yields, suggest that forward-looking returns are likely to be somewhat lower than historical returns.

6.4 Applications across Jurisdictions and Sectors

In our view the above findings should apply across all jurisdictions in Australia and across all sectors. The basic parameters in the CAPM / WACC models are the risk-free rate, the non-diversifiable market risk, the ratio of debt to assets and the cost of debt. There is no reason to suppose that these parameter values vary across Australia.

A possible argument for adopting different SDRs according to economic sector would be that some sectors have less non-diversifiable risk (lower betas) than others. However, we have given cogent reasons for not varying the SDR for conjectural differences on the values of betas.

It is sometimes argued that some benefits, from say health or environmental goods, are uncertain and likely to be undervalued in the long run and should therefore attract a lower discount rate (for example, Victorian Department of Treasury and Finance 2013). But this is a problem of valuation and not of discounting. If goods may be undervalued, the correct response is to review the valuation, not to change the SDR.

Finally, it may be questioned whether regulations imposing costs on private firms should attract a different SDR. Given that we are recommending an APRR based on private market returns and that the benefits accrue largely to private households, as they do for public projects, we would recommend a similar SDR for public regulations as for public projects. If regulations imposing costs on private firms have the effect of displacing private investment, the APRR (reflecting the market return on private investments) is clearly the appropriate benchmark. If, on the other hand, the immediate effect of a regulation is to displace current consumption, prima facie a time preference rate might appear appropriate. However, if displacing current consumption through regulation is politically feasible, the alternatives of raising taxes to fund public investment, or mandating private investment (such as through superannuation), should also be feasible. These alternatives could displace the same amount of current consumption and would yield the APRR, which is therefore the appropriate opportunity cost.

6.5 International Comparisons

Not surprisingly our recommended rate is broadly consistent with the recommended rates in jurisdictions that adopt an opportunity cost of capital as their prime (or only) driver of the recommended SDR. This includes New Zealand at 8 per cent (NZ Treasury 2016), Canada at 8 per cent (Treasury Board of Canada 2007) and the US Office of Management and Budget at 7 per cent (1992, 2003).

On the other hand, several countries recommend a SDR based on the social time preference rate. This includes the United Kingdom at 3.5 per cent (HM Treasury 2011), European Commission at 3 per cent (2014, 2015) and France at 4.5 per cent (OECD 2015). As we warned at the outset, this is not an area where there is much consensus.

7. The Social Discount Rate over Time

We have assumed above that the SDR is constant over time. There are two issues here. One is whether a lower discount rate should be applied to periods in the distant future. The other is whether recommended discount rates should be revised as economic circumstances change? The answer to this second question is clearly 'yes'. Thus, we focus here on the first issue—the case for declining discount rates.

A number of countries adopt a falling long-term SDR, including the United Kingdom, Germany, Norway and China, and this has support in various academic circles. Four arguments are advanced for hyperbolic discounting. These are: ethical considerations to safeguard the welfare of future generations; falling time preference rates or falling rates of return on capital over time; and the use of certainty equivalent discount rates.

First, regarding the welfare of future generations, as Kaplow (2007) argues, the best policy is to invest in the most efficient projects and to ensure that the benefits are distributed as fairy as possible. Efficiency and redistribution are best dealt with separately. Future generations are not in general made better off by the adoption of projects with low rates of return.

Second, turning to time preference rates, some commentators, for example Pearce, Atkinson and Mourato (2006), argue that there is evidence that PTPRs fall in future periods. Individuals are believed to have higher time preference rates between years 1 and 5 than they do between later years, say between years 21 and 25 or between years 51 and 55. However, it is not clear that this applies to time preference rates *once* someone (or a community) reaches year 21 or 51, in which case there is a problem of time inconsistency. With declining discount rates, project *A* may be preferred to project *B* if it starts in year 1, but project *B* could be preferred to project *A* if the project starts in say year 10 or 20. In any case, time preference rates (social or individual) are less relevant when using a SDR based on the opportunity cost of capital.

Third, there is no evidence that the return on capital is trending downward (Burgess and Zerbe 2013). In fact, the opposite view is as plausible—current interest rates and other rates of return are arguably in a cyclical low and might be expected to return to longer term averages over time.

Fourth, we turn to the argument that the use of certainty equivalent discount rates suggest that we should adopt declining SDRs in the long run. This approach is also referred to as 'gamma discounting' after Weitzman (2001) and the intuition can be illustrated as follows. Suppose we want to know the present value of a benefit that will be worth $100 in 50 years' time, but we are unsure whether the correct discount rate is 5 per cent or 10 per cent (with equal probability).

- At 5 per cent, the present value would be ($100) x (1/1.05)^50 = $8.72.
- At 10 per cent, the present value would be ($100) x (1/1.10)^50 = $0.85.

Therefore, the central (average) estimate of present value is ($8.72 + $0.85)/2 = $4.79. The single discount rate that would give $4.79 is 6.3 per cent, that is, ($100) x (1/1.063)^50 = $4.79.

It follows that 6.3 per cent is the 'certainty equivalent discount rate'. But note that 6.3 per cent is lower than the central estimate of the SDR, which would have been (5 per cent + 10 per cent)/2 = 7.5 per cent. Therefore, when we are uncertain about the correct SDR, the discount rate that provides a central estimate of present value is lower than the central estimate of the discount rate. We note that with gamma discounting, time inconsistency is not an issue.

Arrow et al. (2014) discuss the literature on declining discount rates and conclude that 'theory provides compelling arguments for using a declining certainty equivalent discount rate' (p. 160). However, they also note that 'results from the empirical SDR literature are sensitive to the model estimated, the data series used to estimate the model and how the data are smoothed and corrected for inflation'.

Burgess and Zerbe (2013) also contend that the complexity that would be added by a time varying discount rate, combined with the lack of consensus as to how rates should vary, favour the use of a constant rate in most cases. In any case, use of a SDR that declines after 30 or 50 years will make very little difference to most project evaluations, and we already recommend sensitivity testing over a range of discount rates as outlined in Subsection 6.3 above. We conclude that, while there is ongoing discussion of this issue, the arguments are not sufficiently compelling to warrant adoption of a declining discount rate as standard practice.

8. Conclusions

The article concludes that the SDR should be based on the opportunity cost of capital as measured by the estimated rate of return on alternative projects rather than on a time preference rate or weighted costs of funds discount rate. This provides the most efficient outcomes. Undertaking the most efficient projects available produces the highest valued consumption stream that can be obtained. Ensuring inter-temporal equity is an important but separate issue.

The article also recommends that the SDR should be based on average market return allowing for non-diversifiable risk but not for project risk. We do not support varying the allowance for non-diversifiable risk by project as this is not practical. Project risk is important but is dealt with better by analysis of the risks than by varying the SDR.

Drawing on a CAPM / WACC model and current economy parameter values, the article concludes that the appropriate SDR for Australia, for all sectors and all states and territories, is approximately 6.5 per cent, with a sensitivity range from 4.5 per cent to 8.5 per cent. While this rate should be reviewed periodically, the article does not see a compelling case for using a declining SDR over time.

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Endnotes

[1] A real social discount rate excludes inflationary changes. For simplicity, the article refers simply to the social discount rate that implies a real rate per annum unless otherwise specified. This is not a discount rate for financial analysis that includes inflation.

[2] As at August 2017, the RBA cash rate is 1.5 per cent, retail deposits at large banks pay interest of up to 2–3 per cent, and the 10-year bond yield has averaged around 2.5 per cent over the past 12 months.

[3] Some authors use the expression 'Social Time Preference Rate' to refer specifically to pure time preference (θ in equation (2)) rather than to the entire RHS of equation (2). We follow the convention in the discount rate literature (for example, HM Treasury 2011; Moore, Boardman and Vining 2013a), which uses the expression STPR or 'rate of STP' in the broader sense to include both pure time preference and the second term reflecting diminishing marginal utility of income.