NZIER INSIGHT

114-2024

NZIER PUBLIC GOOD PROGRAMME

THINKING ABOUT AOTEAROA NEW ZEALAND'S FUTURE

A price on time

Rethinking the public sector discount rate

The public sector discount rate plays a central role in determining which government interventions get the green light and which stay on red.

The Treasury says it intends to review the discount rate once a year, but it has not done so since mid-2020 – almost four years ago. Since then, interest rates – which underpin the official discount rate – have risen sharply, putting Treasury's guidance out of date.

Why a rethink is needed

Changes since 2020 suggest taking a more in-depth look at the prescribed rate rather than just updating the current numbers.

A new government has come to power with a fresh commitment to making decisions based on rigorous cost-benefit analysis, potentially increasing the influence of the discount rate on government decisions.

At the same time, there is a strong demand for increased government spending in areas such as social investment and infrastructure, which have high initial costs and benefits that occur over multiple decades. The discount rate has a major impact on how these projects are prioritised.

New Zealanders appear to be increasingly concerned about intergenerational equity and justice. Issues such as biodiversity loss, climate change, and social mobility can have very long-term impacts. Because discounting places a value on outcomes for future generations, it has important ethical implications that should be considered.

Discounting is no simple matter

Determining the appropriate discount rate is a complex challenge. Discounting is applied across a wide range of different contexts, each raising separate technical, ethical and political issues. This complexity makes it difficult to arrive at a universal solution, leading to a wide range of perspectives and ongoing debate.

This paper aims to provide public sector workers with an overview of the discourse on discount rates. Rather than starting from first principles, it highlights the key issues and approaches that have shaped the debate.

The structure of this paper

The paper begins with an overview of the discount rate, including how it is used in government decision-making, how it has changed over time, and how it compares to rates used in other countries. Next, it briefly outlines the two main methods for determining the discount rate: social opportunity cost (SOC) and social rate of time preference (SRTP). In the third section, it discusses three important areas of difference between these two approaches. The fourth section considers non-standard approaches that allow the discount rate to vary across types of impacts or periods of time. It concludes by outlining additional factors that should be considered as part of a review of New Zealand's public sector discount rate.

An introduction to the discount rate

What is it, and how is it used?

Comparing costs and benefits across time

In New Zealand, the government's preferred method for assessing public sector interventions is cost-benefit analysis (CBA). CBA involves identifying all the costs and benefits of a decision for society – understood as changes in social welfare or wellbeing – and expressing them in monetary units so that they can be compared against each other.

Costs and benefits occur in different time periods. This raises the question – what is the social value of a cost or benefit that occurs tomorrow compared with one that occurs today?

Resources today are thought to have a higher value than resources in the future for two reasons. First, resources today can be invested and produce more resources for use in the future – this is known as the *opportunity cost*. Second, people prefer to consume today rather than tomorrow because they are impatient, because they might die in the meantime, or because they expect their baseline level of consumption to be higher tomorrow – this is known as *time preference*.[1]

To compare costs and benefits across different time periods, they are assigned present values.[2] The present value of a future cost or benefit is calculated by applying a weight called a social discount factor.

The public sector discount rate (also called the social discount rate) is the rate at which the social discount factor decreases over time.

Under the standard approach, the discount rate is assumed to be constant, which ensures time consistency – if benefit A this year has more value than benefit B next year, then benefit A in 10 years should also have more value than benefit B in 11 years.

With a constant discount rate, denoted r, the social discount factor for a benefit t periods in the future is given by:

$$DF_t(r) = \frac{1}{(1+r)^t}$$

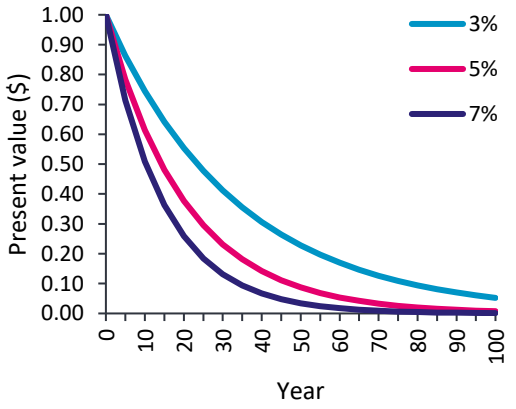
The present value of a future cost or benefit x_t is given by:

$$PV(x_t, r) = DF_t(r) \times x_t = \frac{x_t}{(1+r)^t}$$

The net present value (NPV) is the sum of all present value benefits less the sum of all present value costs. If the NPV is positive, the benefits of the whole project or initiative outweigh the costs.

When the discount rate is constant, the value of future costs or benefits declines exponentially, as shown in Figure 1. With a 3% discount rate, a cost or benefit of $1 in 30 years is worth around 50c today. With a 7% discount rate, it is worth just 20c.

Figure 1 Present value of a $1 cost or benefit under different discount rates



Source: NZIER

[1] A common source of confusion involves conflating time preference with discounting. It is important to keep these concepts separate and remember that time preference is not the only reason resources are more valuable in the present than in the future.

[2] Before assigning present values, costs and benefits must be expressed in real terms (i.e. adjusted for inflation). All figures discussed in this paper are real, including the discount rate.

Another way of thinking about the discount rate is the hurdle rate for a project's internal rate of return. The internal rate of return (IRR) is the annual rate of growth in value that an investment is expected to generate over its lifespan.[3] The discount rate is the minimum IRR that a project must have to be worthwhile.

Effect on project rankings

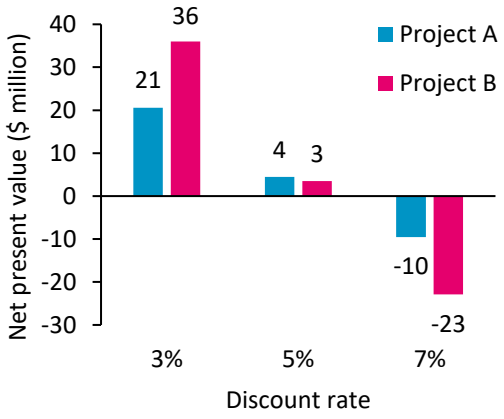
Suppose the government is deciding between two projects that cost $150 million in year 0. Project A provides $20 million in benefits per year for 10 years. Project B provides no benefits in the first nine years and a benefit of $250 million in year 10.[4]

Figure 2 shows the NPV of the two projects under different discount rates. With a discount rate of 3%, project A has a net present value of $21 million, and project B has a net present value of $36 million, so the government prefers project B. With a discount rate of 5%, the government prefers project A, which has an NPV of $4 million, compared to $3 million for project B. With a discount rate of 7%, both projects have negative NPV, and the government prefers not to go ahead with either.[5]

This example illustrates two points:

- For projects with the same costs, a low discount rate favours projects with the highest undiscounted benefits (assuming projects are ranked by their NPV)
- For higher discount rates, less weight is placed on costs and benefits that occur further in the future. This both reduces the size of total benefits and tilts decisions in favour of projects with short-term benefits.

Figure 2 Relationship between the discount rate and the NPV



Source: NZIER

A higher discount rate can also reduce the time horizon over which projects are evaluated as the present value of future costs and benefits declines more rapidly.

Implications for government decisions

The discount rate is primarily used to rank projects against each other. A higher discount rate tends to favour short-term projects with low, upfront costs that deliver immediate benefits, whereas a lower discount rate tends to favour long-term investments with high upfront costs that deliver future benefits.

Arguably, the discount rate also influences the overall level of government spending. As benefits tend to occur further in the future than costs, a lower discount rate means that benefits are likely to outweigh the costs for a wider range of potential policies and projects. Although the total level of government spending is determined separately through the budget process, a lower discount rate makes more projects appear worthwhile, which could favour a larger public sector.

[3] The IRR is calculated by finding the discount rate that makes the NPV equal to zero. For complex projects with irregular cashflows, the IRR equation can have no solution or multiple solutions, creating problems for using the IRR in decision-making.

[4] Although the benefits and costs are presented in monetary terms, they need not be financial – for example, the costs of a project could include environmental damage, and the benefits could include better health outcomes.

[5] Alternatively, the projects can be assessed using the IRR. The IRR of project A is 5.6%, and the IRR of project B is 5.2%. This means that both projects are worthwhile if the discount rate is 3% or 5%, but not if the discount rate is 7%.

The discount rate also has implications for other aspects of government policy. A lower rate implies that the government should attempt to raise the rate of economic growth and encourage more investment across the economy (Cowen 2004). This strengthens the case for policies that promote education and research, flexible markets, strong property rights, and better regulation.

It is important to keep in mind that the discount rate is primarily a practical tool for making real-world policy decisions. While its theoretical underpinnings are important, discussions should focus on how it can best support decision makers while taking account of the wider administrative and political context.

Discount rates in New Zealand

The current rate

The Treasury (2024) currently recommends a discount rate of 5.0% for most projects and a higher rate of 6.0% for telecommunications and IT projects to reflect increased systematic risk. The Treasury (2023) also suggests an alternative rate of 2.0% but does not explain how this should be used.

While a discussion of private sector approaches to discounting is outside of the scope of this paper, the Treasury's discount rate appears to be relatively low compared to typical private sector rates, which vary from roughly 5% to 10% depending on the industry.[6]

How the rate has changed over time

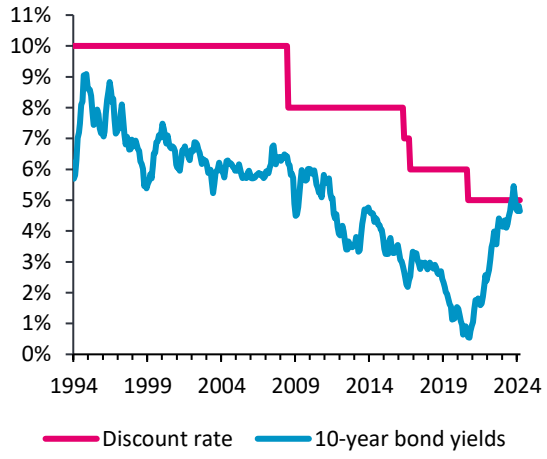
The discount rate has changed over time, and different agencies use different rates. When CBA was first introduced in the 1960s, major government departments used a rate of around 5%, increasing to 7% toward the end of the decade (Copeland and Rose 1975). In 1971, the Treasury instructed departments to use a rate of 10% (The Treasury 1971). This was reduced to 8.0% in 2008 when the Treasury switched to calculating the discount rate based on interest rates using the capital asset pricing model (CAPM), a version of the SOC approach. Over the following 12 years, the discount rate was gradually reduced as interest rates fell, reaching the current value of 5.0% in mid-2020.

In theory, the declining discount rate should have tipped the scale in favour of long-term decisions. However, the extent to which these changes have influenced government policy is unclear.

Since 2020, interest rates have risen significantly, but the Treasury has not updated the discount rate. This has caused the discount rate to become untethered from interest rates. The last time interest rates were at today's level, the Treasury's discount rate was 8.0% – three percentage points above the current value.

Figure 3 compares the evolution of the Treasury's discount rate to long-term bond yields over the past 30 years.

Figure 3 Evolution of the Treasury's discount rate



Source: NZIER

[6] Based on PwC (2022)'s estimates of the nominal weighted average cost of capital (WACC).

A long history of debate

The discount rate has been debated in New Zealand ever since it was introduced. NZIER has long been involved in the discussion, with key contributions by Copeland and Rose (1975) and Parker (2009; 2011).

Recently, the Parliamentary Commissioner for the Environment (2021) and the New Zealand Infrastructure Commission (2022) both recommended that the Treasury review the discount rate to better reflect intergenerational costs and benefits relating to infrastructure and the environment. This suggests that a more fundamental review may be required beyond simply updating the numbers to reflect the latest interest rates.

Application across government

The Treasury discount rate is widely used by government departments. However, some arms-length bodies use different rates.

NZTA currently use a rate of 4.0% when assessing transport infrastructure, calculated using the same approach as Treasury but with different assumptions about the riskiness of transport investments (NZ Transport Agency Waka Kotahi 2024; 2019).

Pharmac (2015) uses an even lower discount rate of 3.5% when ranking health investments based on the after-tax return on long-term government bonds.[7] It argues that this approach better reflects individuals' preferences.

Having different discount rates for different government organisations is at odds with the Treasury's approach and makes it harder to compare different types of government spending.

Discount rates around the world

Different countries use different discount rates. Even among English-speaking countries, rates vary significantly, as shown in Table 1.

Table 1 Discount rates in selected English-speaking countries

Country and agency	Rate	Method
New Zealand Treasury	5.0%	SOC
Australia Office of Best Practice Regulation	7.0%	SOC
Canada Treasury Board Secretariat	7.0%	SOC
United States Office of Management and Budget	2.0%	SRTP
United Kingdom HM Treasury	3.5%	SRTP

Source: NZIER

Australia's Office of Best Practice Regulation (2020) and Canada's Treasury Board (2022) both recommend a discount rate of 7.0%.

The UK Treasury (2022) recommends a lower discount rate of 3.5%, and the US Office of Management and Budget (2023) recommends an even lower discount rate of 2.0%. Both agencies recommend a declining discount for costs and benefits occurring more than 30 years in the future.

Whereas the Australian and Canadian discount rates are based on the SOC approach (similar to the New Zealand Treasury discount rate), the UK and US discount rates are based on the SRTP approach. These methods are described in the next section.

The SOC method has historically been more prevalent than the SRTP method, but the SRTP method is becoming more common (Boardman et al. 2018). Discount rates also tend to be lower in developed countries than in developing countries.

[7] The after-tax return on long-term government bonds is intended to be a proxy for the SRTP, which we discuss below.

Approaches for determining the discount rate

As noted previously, there are two reasons why the resources today are thought to have a different value from resources in the future: *opportunity cost* – resources today can be invested and produce more resources for use in the future – and *time preference* – people prefer to consume today rather than tomorrow because of impatience, the risk of death, and the expected growth in future living standards.

These two justifications for discounting have given rise to two separate methods for determining the public sector discount rate:

- The **social opportunity cost of capital** (SOC) method, which sets the discount rate based on the next best alternative use of government funds, reflected in market interest rates.
- The **social rate of time preference** (SRTP) method, which sets the discount rate by specifying society's preferences for consumption over time, based on the social rate of pure time preference[8] and expected growth in future living standards.

In theory, under specific assumptions, these two approaches will produce the same estimates. The key assumptions are:

- There is a perfectly competitive market with no market failures or transaction costs.
- Everyone can borrow or save as much as they want at the same interest rate.
- Society's rate of pure time preference aligns with individuals' rates, as revealed by market prices.

If markets are perfectly competitive and there is a single interest rate, individuals will adjust their borrowing and saving behaviour until the rate at which they are willing to substitute current for future consumption matches the market interest rate. If society's pure time preference rate aligns with the individuals' rates as revealed by market prices, then the market interest rate will also reflect the societal rate.

The problem is that these assumptions are unrealistic. Market failures and transaction costs mean that market interest rates may not reflect individual preferences. In addition, there are many ways of borrowing and saving with different levels of risk and different rates of return, making it unclear which interest rate best reflects time preferences and returns to capital. Finally, some argue that the social rate of pure time preference should be different from individual rates.

These issues have given rise to a fierce debate in both policy circles and academic literature that has lasted for more than sixty years.

The SOC method sets the discount rate based on market interest rates

The Treasury uses the SOC approach to calculate its discount rate. Under this approach, the public sector discount rate reflects the opportunity cost of government investment – that is, the social rate of return on the next best alternative.

The Treasury assumes that the next best alternative is increased investment in the private sector. It is based on the idea that if the government does not undertake the project, it could invest the public funds in the share market and distribute the proceeds. As the Treasury (2008) argues, the government does, in fact, invest in the share market through ACC and the New Zealand Superannuation Fund. It varies its contributions from time to time-based on its budget position, which depends on the number of projects it undertakes.

[8] The social pure time preference rate is the rate at which society values future welfare compared to present welfare, assuming that consumption is equal.

The logic behind the Treasury's approach is simple: if public investments did not yield at least as high a return as private investments with similar risk, then society would be better off choosing that alternative instead.

Whereas the private sector aims to maximise financial returns, the government should be concerned with social welfare. The Treasury implicitly assumes that the financial return on the share market is a reasonable approximation for the social return. However, private sector investments may have costs or benefits that are not reflected in market prices. In the presence of negative externalities, such as pollution, the social rate of return will be lower than the financial rate of return. In the presence of positive externalities, such as the creation of new technology, it will be higher.

To calculate the rate of return on private sector investments, the Treasury uses the capital asset pricing model (CAPM).[9] This model states that the expected rate of return from a private sector project is equal to the risk-free rate of return plus an equity premium that depends on the riskiness of the project relative to the share market.

In the simplest version of the CAPM,[10] the rate of return is calculated as:

$$SOC = r_f + \beta(r_m - r_f)$$

where r_f is the risk free rate of return, $r_m - r_f$ is the equity risk premium (the difference between the expected rate of return from the share market r_m and the risk free rate), and β is the beta coefficient, which is a measure of how the riskiness of the project compares to the share market.

r_f is estimated using yields on long-term (i.e. 10 years) government bonds, r_m is estimated from the share market based on historical returns, and β is estimated based on the relationship between private projects with a similar risk and share market returns.

The SRTP method involves directly specifying society's preferences

Under the social time preference approach, the public sector discount rate reflects society's willingness to trade off consumption today for consumption tomorrow.

The discount rate is calculated using the Ramsey formula. The formula is derived from a model with infinite periods in which society maximises a social welfare function that represents preferences for consumption per person over time (including over multiple generations).

According to the Ramsey formula, the discount rate is:

$$SRTP = \rho + g\,\varepsilon$$

where ρ is the social rate of pure time preference, g is the rate of consumption growth, and ε represents society's preference for smoothing consumption over time.[11]

ρ can be estimated empirically through experiments, stated preference surveys, or the analysis of savings behaviour and interest rates but is often specified based on ethical and philosophical arguments. g can be estimated based on past growth rates, and ε can be inferred from asset prices. Tait (2023) suggests $\rho = 1.5$, $g = 1.45$, and $\varepsilon = 1.5$, resulting in an overall rate of 3.7%.

Alternatively, the SRTP is sometimes assumed to equal the risk-free rate, which is approximated by the after-tax return on 10-year government bonds. Pharmac adopts this approach, resulting in a rate of 3.5%.

9 The CAPM model is widely used in the finance sector as it is easy to apply and is based on modern portfolio theory. However, it is based on simplifying assumptions and may not fully explain asset returns. More sophisticated models have been proposed in the literature, such as the Fama-French three factor and five factor models.

10 The Treasury use a more complicated formula that includes adjustments for tax and inflation, see The Treasury (2008).

11 ε can also be understood as society's aversion to intertemporal inequality.

Differences between the two methods

Many variants of the SOC and SRTP methods have been proposed in the literature and are being used around the world. While a full review of the literature is outside of the scope of this paper, this section highlights three major areas of difference between the two methods: how they reflect opportunity cost, risk and liquidity, and time preference.

Reflecting opportunity cost

As discussed previously, the Treasury's SOC approach assumes that the alternative to a public sector project is increased investment in the private sector through the share market. It attempts to measure the social rate of return on investment – the additional welfare that society can produce from an additional unit of investment.

The SRTP approach makes a different assumption. By setting the discount rate based on society's willingness to trade off consumption over time, it implicitly assumes that the alternative is for people to increase consumption. The SRTP approach attempts to measure the social rate of return on consumption – the rate at which consumers are willing to trade current consumption for future consumption.

Some economists argue that a more realistic alternative is a combination of investment and consumption (Harberger 1972). If the government decides not to undertake a project, it will not generally invest the funds in the share market. Instead, it will return them to households either by cutting taxes or reducing borrowing. While some of these funds will be used for private investment, some will also be used to raise consumption.

The Harberger method

The SOC and SRTP approaches can both be modified to reflect this idea. The modified version of the SOC approach is known as the Harberger or weighted SOC method (see Boardman et al. 2018b). This method calculates the discount rate as the weighted sum of the return on investment and the rate of return on consumption, where the weights reflect the extent to which government projects reduce investment or consumption.[12] The formula is:

$$WSOC = wr_C + (1 - w)r_I$$

where w is the contribution of consumption toward funding the project, $1 - w$ is the contribution of investment, r_C is rate of return on consumption, and r_I is the rate of return on investment.

The shadow price of capital approach

The SRTP approach can be modified by applying the shadow price of capital (SPC) approach (see Boardman et al. 2018b; Parker 2011). Under this approach, funds that displace investment are converted to consumption equivalents by multiplying by the SPC before discounting at the SRTP. The SPC is the present value of investing a dollar in the private sector, earning a rate of return r_I which is consumed in each period.[13] It is given by:

$$SPC = \frac{r_I}{r_C}$$

These modifications bring the SOC and SRTP approaches closer together. They both introduce complexity, making the discount rate more difficult to estimate. Allowing analysts to specify the portion of funds that displace consumption or investment can open the door to subjectivity and manipulation. The SPC approach also makes NPV calculations harder to perform and understand.

[12] A more sophisticated version of this method also incorporates the potential for funds to be raised through foreign borrowing. See Boardman et al. (2018).

[13] In a more sophisticated formula for the SPC, a fraction of the return is consumed, and a fraction is reinvested.

Reflecting risk and liquidity

The Treasury's SOC approach to estimating the discount rate assumes that the risk involved in government projects is similar to private sector projects and that the government treats risk in the same way as private sector firms. It includes an explicit adjustment for systematic risk, which is based on the sensitivity of the project's returns to overall market movements.

The standard SRTP approach, on the other hand, does not account for risk and treats all projects the same, regardless of the level of systematic risk.

This raises two questions:

- How does the government's ability to manage risk compare to the private sector?
- Should the discount rate vary from project to project depending on the level of systematic risk?

The government's ability to manage risk

Some economists, such as Baumol (1968), argue that treating risk in the same way as the private sector is appropriate because whether an investment is delivered by the government or by the private sector does not affect the risks involved or the benefits it brings to society.

Other economists, such as Arrow and Lind (1970), argue that the government can manage idiosyncratic risk more effectively than private sector firms because it spreads risk across all members of society. This implies that the discount rate should be lower than the market interest rate.

A third group of economists argue that because people cannot control their exposure to government investments, government investments lead to a risk misallocation, implying the discount rate should be higher than the market interest rate (Stapleton and Subrahmanyam 1978).

These arguments imply that society prefers projects to be delivered by the government rather than the private sector (or vice versa) because of its different ability to manage risk, and they suggest that this should be incorporated into the discount rate. They introduce a new role of government that many people may not be comfortable with.

A reasonable middle ground may be to assume that the government's overall ability to manage risk is similar to that of the private sector. This would also ensure that the discount rate does not favour either public or private provision in areas where the government competes with private sector firms (examples include healthcare, education, banking, and postal services).

Reflecting systematic risk

The next question is whether the discount rate should reflect different levels of systematic risk involved with different types of projects.

The Treasury adjusts its base discount rate for projects in different sectors by varying the beta coefficient. The logic behind this is that, like private investors, the government should require a lower rate of return from projects when the risk is less correlated with the share market because this results in a more diversified portfolio of investments.

This approach has three key limitations. First, Treasury estimates beta coefficients by analysing equity returns and financial leverage data for a small number of representative private sector firms. These estimates are extremely rough and may be unreliable.

Second, government projects may have different risk profiles from projects undertaken by publicly listed companies. Government projects often provide different types of services from private projects and use different financial, commercial and management arrangements. This makes it difficult to find appropriate private sector comparators.

The third and most important limitation is that the Treasury's CAPM approach focuses on financial risk. As noted in the previous section, the government should be more concerned with social welfare. As public sector investments produce public goods and externalities that are not captured in market prices, social welfare risk may differ from financial risk. This indicates that estimating beta coefficients from financial markets is not appropriate. A more theoretically correct approach – known as the consumption CAPM – uses beta coefficients that reflect correlation with consumption rather than share market returns. This approach is even more challenging to apply.

Rather than varying the discount rate according to exposure to systematic risk, a simpler and more achievable approach is to use a discount at a single rate reflecting the overall risk involved in private sector investments. Assuming public sector projects have the same social welfare systematic risk overall as the financial risk of private sector projects – although unrealistic – seems like a more realistic base assumption than assuming they are risk-free.

Project-specific risk can be analysed separately through sensitivity analysis or Monte Carlo simulation (Boardman et al. (2018) provide a useful overview).

Adjusting for liquidity

A related issue is liquidity. Coleman (2019) argues that share market returns include a liquidity premium to compensate investors for liquidity risk – the risk of being unable to sell assets quickly without losses. As the government can borrow against future tax revenue, it is better at managing liquidity risk than the private sector. This suggests that the government should use a lower liquidity premium when discounting public sector investments, resulting in a lower discount rate.

Coleman proposes separating the liquidity premium from the base discount rate. He notes that, in practice, the government undertakes a two-stage process: first, ranking projects using a discount rate based on share market returns, then deciding how many to undertake based on its debt position. As the second stage implicitly accounts for liquidity risk, Coleman argues that the rate used in the first stage should be lower.

The difficulty with Coleman's argument is that if the government has a lower liquidity premium for investing in projects, then it also has a lower liquidity premium for investing in the private sector. The relative attractiveness of these options does not change, so the share market rate of return still provides an appropriate benchmark when ranking projects.

Reflecting time preference

A third important difference between the SOC and SRTP methods is that the SRTP method allows the social rate of pure time preference, which reflects society's choice to consume today rather than tomorrow, to be set separately from individual rates.

The SOC method arguably assumes that these two rates are linked. It sets the public sector discount rate, which reflects social time preferences, to equal market interest rates, which reflect individuals' time preferences.

The SRTP method explicitly specifies the social rate of time preference. In some cases, it is set to equal the individual rate for a typical person, which can be estimated using experimental studies, stated preference surveys, or by analysing people's consumption, savings, and investment decisions.

Arguments for a lower social rate

It is not obvious that social time preferences should be related to individual preferences. As Creedy and Passi (2017) point out, people who make decisions on behalf of society may make different choices than when making decisions on behalf of their household.

Whereas an individual's pure time preference rate reflects their preferences over consumption at different points in their life, society's rate also reflects preferences over consumption for different generations. This means it involves comparisons between different people, not just comparisons between different points in time.

Many economists and philosophers argue that the social pure time preference rate should be lower than individual rates. Ramsey (1928) claimed that a value greater than zero is "ethically indefensible." Drawing on the work of John Broome, Stern famously used a similar argument to justify a very low 1.4% discount rate in the Stern Review report on the economics of climate change (2007). Tait (2023) claims that a te ao Māori perspective supports a zero social rate of pure time preference.

Opposing views

These arguments reflect the view that, even if individuals prefer to consume now than later, society should treat all generations equally. A problem with these arguments is that a low social rate of pure time preference leads to counterintuitive results.

Arrow (1995) shows that a social pure time preference rate of zero implies that the current generation should save two-thirds of its income or more – an unreasonably high amount. This leads him to suggest a pure time preference rate of 1.0%.

More recently, Eden (2023) points out that, under standard economic assumptions, valuing future generations more highly than individuals do is inconsistent with treating all living age groups equally. In particular, if the market interest rate is 6%, then a 1.5% discount rate implies that it is better to increase the consumption of a 20-year-old by $6 than to increase the consumption of an 80-year-old by $100. Intuitively, if the government cares more about future generations than individuals do (as reflected in a lower social rate of time preference), then it wants to shift consumption to future generations. The most straightforward way to do this while respecting individual preferences is to allocate more consumption to younger people in each period. If the social pure time preference rate is set below the rate implied by market interest rates, then consistency requires reducing transfers to the elderly while increasing spending on the young.

There is also an ethical argument for a positive social pure time preference rate: it reflects the idea that we have greater ethical obligations to those closer to us in time and space, such as our families or people from our city or country than those further away. This view rejects the idea that society should treat all generations equally.

Non-standard approaches

The discussion so far has generally assumed that there is a single discount rate that is the same for both market and non-market impacts and is constant over time.

In this section, we discuss alternative approaches that allow the discount rate to vary for different types of impacts or over different periods of time.

Differential discount rates

Public investments often aim to correct market failures, provide public goods and address externalities. They provide benefits that do not have market prices, such as improved quality of life, national security, or social cohesion.

This raises the question of whether non-market costs and benefits should be discounted in the same way as market ones. Some economists have argued that different discount rates should be used.

In a recent paper, Grimes (2024) argues that whereas market costs and benefits should be discounted using a rate based on the SOC approach, non-market costs and benefits should be discounted using a rate based on

the SRTP approach. Furthermore, he argues that society may have different time preferences for different goods, resulting in multiple discount rates.

As Grimes (2024) recognises, the intuition behind dual discounting – that the value of many non-market benefits, such as environmental benefits, should not decline at the same rate as market benefits – can be explained by rising relative prices. As the relative scarcity of non-market goods increases, their prices rise, causing the value of non-market benefits to increase over time. It would be more transparent to model the increasing value of non-market benefits explicitly in CBA than to build it into the discount rate.

Declining discount rates

In recent years, many countries have moved toward declining discount rates for long-term projects. There are three main reasons for this.

The logic of exponential growth

The first reason for declining rates is that exponential discounting with a constant rate produces counterintuitive results. For example, at the Treasury's current discount rate of 5%, it is not worth spending $100 today to avert a major disaster that costs $1 trillion in five hundred years.

While exponential discounting may be counterintuitive, there is a logic to it. If the share market is expected to return 5% over the five-hundred-year period, then $100 invested in the share market would lead to returns of almost $4 trillion, making society better off despite the disaster.

Reflecting individual behaviour

The second reason for using declining discount rates is that it better reflects the way people behave. Empirical evidence shows that individuals tend to apply lower discount rates to events further in the future – a pattern better described by hyperbolic than exponential discounting (Laibson 1997).

Hyperbolic discounting creates time inconsistency, which leads people to reverse their decisions in the future. Individuals who recognise their time inconsistency use commitment devices to prevent decision reversals, such as using automatic savings plans with large penalties for early withdrawals.

The government also often exhibits time inconsistency – consider recent commitments to extend the emissions trading scheme to agriculture or raise the retirement age – and it has fewer mechanisms to prevent decision reversals. Decision reversals undermine the credibility and effectiveness of government policy. As a tool to support better decision-making, CBA should support the government to adopt a more consistent approach rather than emulate individual behaviour.

A mathematical argument

The third reason is that uncertainty about the discount rate results in an expected rate that declines over time (Weitzman 1998). Because discount factors decline non-linearly, overestimating the discount rate leads to a larger error in the discount factor than underestimating it by the same amount. This is the result of a mathematical rule known as Jensen's inequality:

$$E\left[\frac{1}{(1+r)^t}\right] < \frac{1}{(1+E[r])^t}$$

To see how this works, recall project A, which costs $150 million in year 0 and provides $20 million in benefits per year for 10 years. Suppose there is a 50% chance the appropriate discount rate is 7% and a 50% chance it is 3%. The average discount rate is 5%, which would imply an NPV of $4 million. However, the 7% discount rate results in an NPV of -$10 million, and the 3% discount rate results in an NPV of $21 million, resulting in an average NPV of $5.5 million. Using the average value discount rate underestimates the average NPV. The further we look into the future, the greater the uncertainty in the

discount rate. This means that the discount rate should decline over time.

This argument treats the future benefits of the project as certain and the discount rate as uncertain. In practice, the benefits are likely to be at least as uncertain as the discount rate. Moreover, the benefits may be correlated with the discount rate, so circumstances that result in a low discount rate may also result in low future benefits. It is inconsistent to account for the uncertainty in discount rates without also accounting for the uncertainty in future costs and benefits.

The Chichilnisky criterion

Even with declining discount rates, the value assigned to costs and benefits for generations eventually falls to zero. In other words, the interests of generations in the present and near future dominate the interests of generations in the distant future.

Chichilnisky (1995) argues that decision making should strike a balance between the interests of present and future generations. She proposes a criterion that evaluates a project based on a weighted average of two components:

- The discounted welfare of people in the present and near future
- The non-discounted welfare of people in the distant future.

While theoretically appealing, the Chichilnisky criterion is difficult to apply in practice. Determining appropriate weights may be subjective and contentious, and assessing the impact of a public sector project on the welfare of people in the distant future is highly uncertain.

Looking towards a review

In this paper, we have provided an overview of two main methods used to determine the discount rate and discussed three important areas of difference between them. We also discussed non-standard approaches that allow the discount rate to vary for different types of impacts and across different periods of time.

To conclude, we outline additional factors that should be considered as part of a review of New Zealand's public sector discount rate.

Aligning with the purpose of CBA

According to the Treasury (2015), CBA is "primarily about organising available information in a logical and methodical way". It is a tool to support political decisions by democratically elected representatives. CBA aims to present information to decision makers in a way that helps them base decisions on evidence and logic rather than pure prejudice or instinct.

The discount rate should remain aligned with this purpose. While many complex issues need to be considered, the discount rate needs to be as simple and easy to use as possible – the aim is to have a common approach applied widely across public investments. Decision makers and the analysts who support them need to understand what the discount rate represents, how it is determined, and how varying the discount rate affects the project's NPV.

Decision makers can – and often do – choose to ignore the CBA and proceed with projects that have a negative NPV. In some cases, there are political or strategic reasons why a project should go ahead, even if it does not provide value for money from an economic perspective. What is important is that the information is presented to them in a clear, consistent, and rigorous way – with any omissions and assumptions highlighted – so that they can be as informed as possible.

Adopting a consistent approach

As far as possible, a consistent approach to discounting should be used across most public sector projects, underpinned by robust economic theory. Allowing the approach to vary creates room for subjectivity and manipulation and makes it more difficult to compare projects, preventing decision makers from making trade-offs between different types of spending. However, including sensitivity analysis for higher and lower discount rates (e.g. plus or minus 2 percentage points) can help decision makers understand how the discount rate affects the case for the project.

The Treasury should set clear expectations about when the recommended approach should be used and when more careful consideration is required. A discount rate that is appropriate for marginal changes may be inadequate for transformational projects that significantly impact economic growth, such as wide-ranging economic reforms or projects intended to prevent climate change and major natural disasters (Grimes 2010; Cowen 2007). More sophisticated analysis may be warranted to explore how costs, benefits and the discount rate might vary across different future scenarios.

Uncovering political and ethical views behind the discount rate

Arguments about the discount rate are often motivated by political views about the role of government in society or ethical views about what we owe to future generations. Unfortunately, these views are not always made explicit.

The Treasury's SOC approach reflects the view that the next best alternative to a public sector project is for the government to invest in the private sector and that the financial returns from private sector investments are a reasonable measure of the social returns. Proponents argue that the discount rate should create a level playing field between public and private sector projects.

Many versions of the SRTP approach reflect the view that the government should place more weight on future generations' interests than individuals typically do and that society tends to underinvest in long-term projects. Supporters tend to believe that the government should correct this underinvestment by undertaking some projects with a rate of return that the private sector would not accept.

Policy advisors face difficulties in making these judgements on behalf of society without clear evidence of New Zealanders' views on these complex issues. Incorporating value judgements into the discount rate that do not reflect New Zealanders' views could potentially undermine confidence in government decisions. The credibility of public sector advice depends on taking a balanced and transparent approach.

References

Arrow, Kenneth. 1995. 'Intergenerational Equity and the Rate of Discount in Long-Term Social Investment'. Working Paper. IEA World Congress. https://econpapers.repec.org/paper/wopstanec/97005.htm.

Arrow, Kenneth J., and Robert C. Lind. 1970. 'Uncertainty and the Evaluation of Public Investment Decisions'. *The American Economic Review* 60 (3): 364–78.

Australian Government Department of the Prime Minister and Cabinet Office of Best Practice Regulation. 2020. 'Cost-Benefit Analysis'. Guidance Note. https://oia.pmc.gov.au/sites/default/files/2021-09/cost-benefit-analysis.pdf.

Baumol, William J. 1968. 'On the Social Rate of Discount'. *The American Economic Review* 58 (4): 788–802.

Boardman, Anthony E., David H. Greenberg, Aidan R. Vining, and David L. Weimer. 2018. *Cost-Benefit Analysis: Concepts and Practice*. 5th ed. Cambridge University Press. https://doi.org/10.1017/9781108235594.

Chichilnisky, Graciela. 1995. 'An Axiomatic Approach to Sustainable Development', October.

Coleman, Andrew. 2019. 'Liquidity, the Government Balance Sheet, and the Public Sector Discount Rate'. 19–13. Motu Working Paper. Motu Economic and Public Policy Research. https://motu-www.motu.org.nz/wpapers/19_13.pdf.

Copeland, M. C., and W. D. Rose. 1975. 'The Determination of a Public Sector Discount Rate'. NZIER Report for the Treasury. https://nzier.sharepoint.com/Library/Collection%20-%20NZIER/2011%20scanned%20reports/2003190.pdf.

Cowen, Tyler. 2004. 'Policy Implications of Zero Discounting: An Exploration in Politics and Morality'. *Social Philosophy and Policy* 21 (1): 121–40. https://doi.org/10.1017/S0265052504211062.

———. 2007. 'Caring about the Distant Future: Why It Matters and What It Means' 74:5.

Creedy, John, and Hemant Passi. 2017. 'Public Sector Discount Rates: A Comparison of Alternative Approaches'. Working Paper 17/02. New Zealand Treasury. https://onlinelibrary.wiley.com/doi/10.1111/1467-8462.12252.

Eden, Maya. 2023. 'The Cross-Sectional Implications of the Social Discount Rate'. *Econometrica* 91 (6): 2065–88. https://doi.org/10.3982/ECTA20844.

Grimes, Arthur. 2010. 'The Economics of Infrastructure Investment: Beyond Simple Cost Benefit Analysis'. Motu Working Paper 10–05. Motu Economic and Public Policy Research Trust. https://motu-www.motu.org.nz/wpapers/10_05.pdf.

———. 2024. 'Discounting the Future: A New Economic Approach'. Paper for presentation to New Zealand Association of Economists. Wellington.

Harberger, Arnold C. 1972. 'On Measuring the Social Opportunity Cost of Public Funds'. In *Project Evaluation: Collected Papers*, edited by Arnold C. Harberger, 94–122. London: Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-01653-2_4.

HM Treasury. 2022. 'The Green Book: Appraisal and Evaluation in Central Government'. https://assets.publishing.service.gov.uk/media/6645c709bd01f5ed32793cbc/Green_Book_2022__updated_links_.pdf.

Laibson, David. 1997. 'Golden Eggs and Hyperbolic Discounting'. *The Quarterly Journal of Economics* 112 (2): 443–77.

New Zealand Infrastructure Commission. 2022. 'Rautaki Hanganga o Aotearoa New Zealand Infrastructure Strategy: 2022 - 2052'. Wellington, New

Zealand. https://media.umbraco.io/te-waihanga-30-year-strategy/mmahiykn/rautaki-hanganga-o-aotearoa-new-zealand-infrastructure-strategy.pdf.

NZ Transport Agency Waka Kotahi. 2019. 'Discount Rate and Analysis Period: A Technical Paper Prepared for the Investment DecisionMaking Framework Review'. https://www.nzta.govt.nz/assets/planning-and-investment/docs/investment-decision-making-framework-review-discount-rate-november-2019.pdf.

———. 2024. 'Monetised Benefits and Costs Manual'. Version 1.7. https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf.

Office of Management and Budget. 2023. 'Circular No. A-4'. https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf.

Parker, Chris. 2009. 'The Implications of Discount Rate Reductions on Transport Investments and Sustainable Transport Futures'. Research report 392. NZ Transport Agency. https://www.nzta.govt.nz/assets/resources/research/reports/392/docs/392.pdf.

———. 2011. 'Economics like There's No Tomorrow'. Insight 32/2011. NZIER. https://www.nzier.org.nz/hubfs/Public%20Publications/Insights/nzier_insight_32_-_economics_like_theres_no_tomorrow.pdf.

Parliamentary Commissioner for the Environment. 2021. 'Wellbeing Budgets and the Environment: A Promised Land?' https://pce.parliament.nz/media/lxgb4pt5/wellbeing-budgets-and-the-environment-report-pdf-225mb.pdf.

Pharmac. 2015. 'Prescription for Pharmacoeconomic Analysis: Methods for Cost-Utility Analysis'. Version 2.2. https://pharmac.govt.nz/assets/pfpa-2-2.pdf.

PwC New Zealand. 2022. 'Cost of Capital Report 2022'. https://www.pwc.co.nz/pdfs/2022/cost-of-capital-report-2022.pdf.

Ramsey, F. P. 1928. 'A Mathematical Theory of Saving'. *The Economic Journal* 38 (152): 543. https://doi.org/10.2307/2224098.

Stapleton, R. C., and M. G. Subrahmanyam. 1978. 'Capital Market Equilibrium in a Mixed Economy, Optimal Public Sector Investment Decision Rules, and the Social Rate of Discount'. *The Quarterly Journal of Economics* 92 (3): 399–411. https://doi.org/10.2307/1883151.

Stern, N. H., ed. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge, UK ; New York: Cambridge University Press.

Tait, Peter. 2023. 'Social Discount Rates in Cost Benefit Analysis of Regional Pest Management Plans: Guidance and Recommendations for the Uninitiated'. AERU Research Report 382. Lincoln University: Agribusiness and Economics Research Unit. https://bioheritage.nz/wp-content/uploads/2023/08/Social-Discount-Rates-in-Cost-Benefit-Analysis.pdf.

The Treasury. 1971. 'Discount Rate for Project Evaluation in Government'.

———. 2008. 'Public Sector Discount Rates for Cost Benefit Analysis', July.

———. 2015. 'Guide to Social Cost Benefit Analysis'. https://www.treasury.govt.nz/sites/default/files/2015-07/cba-guide-jul15.pdf.

———. 2023. 'CBAx Tool User Guidance'. https://www.treasury.govt.nz/publications/guide/cbax-tool-user-guidance.

———. 2024. 'Discount Rates'. 8 April 2024. https://www.treasury.govt.nz/inform

ation-and-services/state-sector-leadership/guidance/reporting-financial/discount-rates.

Treasury Board of Canada Secretariat. 2022. 'Canada's Cost-Benefit Analysis Guide for Regulatory Proposals'. Ottawa, Ontario. https://www.canada.ca/en/government/system/laws/developing-improving-federal-regulations/requirements-developing-managing-reviewing-regulations/guidelines-tools/cost-benefit-analysis-guide-regulatory-proposals.html.

Weitzman, Martin L. 1998. 'Why the Far-Distant Future Should Be Discounted at Its Lowest Possible Rate'. *Journal of Environmental Economics and Management* 36 (3): 201–8. https://doi.org/10.1006/jeem.1998.1052.

This Insight was written by Adrian Katz at NZIER, August 2024

Assistance from John Yeabsley, Sarah Hogan and Sarah Spring is gratefully acknowledged. The Author is grateful to Andrew Coleman for his comments on an earlier draft.

For further information please contact Adrian at adrian.katz@nzier.org.nz or 027 265 1955

How to cite this document:

Adrian Katz. 2024. A price on time: rethinking the public sector discount rate. NZIER Insight 114-2024. Available at https://www.nzier.org.nz/publications/a-price-on-time-rethinking-the-public-sector-discount-rate-nzier-insight-114

NZIER | (04) 472 1880 | econ@nzier.org.nz | PO Box 3479 Wellington