# Social discounting: the SOC/STP divide

## Michael Spackman

**February 2017**

Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

ESRC Economic & Social Research Council

THE GRANTHAM FOUNDATION FOR THE PROTECTION OF THE ENVIRONMENT

UNIVERSITY OF LEEDS

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

**The Centre for Climate Change Economics and Policy (CCCEP)** was established by the University of Leeds and the London School of Economics and Political Science in 2008 to advance public and private action on climate change through innovative, rigorous research. The Centre is funded by the UK Economic and Social Research Council. Its second phase started in 2013 and there are five integrated research themes:

1. Understanding green growth and climate-compatible development
2. Advancing climate finance and investment
3. Evaluating the performance of climate policies
4. Managing climate risks and uncertainties and strengthening climate services
5. Enabling rapid transitions in mitigation and adaptation

More information about the Centre for Climate Change Economics and Policy can be found at: www.cccep.ac.uk.

**The Grantham Research Institute on Climate Change and the Environment** was established by the London School of Economics and Political Science in 2008 to bring together international expertise on economics, finance, geography, the environment, international development and political economy to create a world-leading centre for policy-relevant research and training. The Institute is funded by the Grantham Foundation for the Protection of the Environment and the Global Green Growth Institute. It has nine research programmes:

1. Adaptation and development
2. Carbon trading and finance
3. Ecosystems, resources and the natural environment
4. Energy, technology and trade
5. Future generations and social justice
6. Growth and the economy
7. International environmental negotiations
8. Modelling and decision making
9. Private sector adaptation, risk and insurance

More information about the Grantham Research Institute on Climate Change and the Environment can be found at: www.lse.ac.uk/grantham.

# Social discounting: the SOC/STP divide*

Michael Spackman[1]

Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science and NERA Economic Consulting

More than 50 years of social discounting literature has not delivered to government practitioners satisfactory academic guidance.  Users of the social opportunity cost (SOC) paradigm do not always appreciate that it is inappropriate for 'choice of technique' analysis.  Users of the social time preference (STP) paradigm do not always appreciate that, for cost benefit analysis, separate account needs to be taken of the opportunity cost of public spending relative to consumption.  Recent papers, by leading SOC advocates and by the US Council of Economic Advisers, open a window for a better understanding of both paradigms.  The paper offers, from an experienced practitioner's perspective, theoretical and operational observations to help advance, where possible, understanding within institutions where debate on these paradigms is active.

Keywords: cost benefit analysis, discounting, public investment, social opportunity cost, social time preference

JEL Classifications:  D61, D81, D90

---

## Abbreviations

BCR     Benefit cost ratio

CBA     Cost benefit analysis (i.e. comparing public spending with consumption benefits); Benefit cost analysis (BCA) in the US

CAPM   Capital asset pricing model; CCAPM   Consumption capital asset pricing model

CEA     [US] Council of Economic Advisers

CoTA    'Choice of technique analysis', often described as cost effectiveness analysis (i.e. comparing alternative streams of public spending, or alternative streams of consumption)

NPV     Net present value

OCPF    Opportunity cost of public funding (defined here as a ratio (>1), for comparing dollars of public spending with dollars of private spending)

OMB     [US] Office of Management and Budget

RFIR     Risk free interest rate

SDR     Social [time] discount rate

SOC     Social opportunity cost (as a percentage rate, or as an approach to social time discounting)

SPIF     Shadow price of investible funds

STP     Social time preference (as a percentage rate, or as an approach to social time discounting); described as SRTP (social rate of time preference) by the CEA

WACC   Weighted average cost of capital

## 1.      Introduction

Sixty years of literature on public sector time discounting have not led to common understanding on fundamentals. The two most common paradigms, described usually as Social Opportunity Cost (SOC) and Social Time Preference (STP), emerged in the 1960s and have subsequently evolved, like animal species, along different paths. The paper draws heavily on important papers by leading advocates of the SOC paradigm (Harberger and Jenkins 2015 and Burgess and Zerbe 2011; henceforth H&J2015 and B&Z2011) and on an Issue Brief of the US Council of Economic Advisers (CEA 2017, henceforth CEA2017). The CEA Brief itself draws on B&Z2011 in presenting, in a US context, a balanced picture of current academic views.[2,3]

This paper is written from the perspective of a practitioner who has worked on implementing both SOC and STP regimes, has followed the literature over many decades and, with qualifications, favours the STP paradigm. It is written with a view mainly to

---

[2]   The CEA paper was published on the White House website shortly before the change of administration, which removed all of the previous administration's material. Much of that material is now available at obamawhitehouse.archive.gov, but no exploration is made in this paper of the future of the OMB or of US federal guidelines.

[3]   B&Z2011 (and subsequently Burgess 2013) also assess an approach described as "marginal cost of funds". This however is not discussed further here. Burgess and Zerbe also contributed in 2013 to an exchange with Canadian advocates of STP (Burgess and Zerbe 2013; Moore et al 2013a, 2013b). That exchange illustrates the difficulty of effective communication between disciples of these two paradigms.

advancing, where this is possible, mutual understanding within institutions where this fundamental social discount rate (SDR) debate is active.

Section 2 below outlines current SDR regimes across national governments and international institutions.  Section 3 addresses the core arguments, especially the two issues where perspectives appear to differ most fundamentally.  Section 4 discusses the opportunity cost of public funding (OCPF).  Section 5 summarises key points and practical approaches.  Appendix A discusses the estimation of social time preference.  Appendix B briefly covers some further issues that are significant but would clutter the main text.

## 2. Current paradigm choices

Practical regimes for public sector discounting today can be broadly categorised under five, slightly overlapping headings as follows.

**SOC regimes:** Some countries, states and provinces, notably New Zealand and federal governments of Australia and Canada, apply SOC discount rates, typically in high single figures.[4]  The US (OMB 1992) specifies such a rate (of 7%, based on the return to business capital) to the comparison in CBA of consumption benefits with public spending.[5]

**STP regimes:** Most European-wide institutions and some European countries apply STP discount rates, typically in low single figures.  The US (OMB 2016) specifies such a rate (3%, based on the real rate of return on long-term government debt) for regulatory appraisal where the impact is on consumers rather than business investment.

**Risk free interest rate (RFIR) regimes:** Some countries, including Norway, with other Scandinavian countries tending that way, apply discount rates based more explicitly on government borrowing rates.  The US OMB specifies for *'cost-effectiveness, lease purchase, and related analyses'* it specifies a rate equal to the government borrowing rate for an appropriate term.  CEA2017 refers to "the common practice of using Treasury rates as a proxy for the SRTP", but some administrations might use RFIRs as a measure of social opportunity cost.  RFIRs are generally lower than conventional STP rates.  However RFIR regimes may also include a systemic risk premium, bringing rates similar to or higher than those of most STP regimes.[6]

**Dual, or multiple approaches:** Sometimes different regimes are specified for 'choice of technique' analysis (CoTA) and cost benefit analysis (CBA/BCA) and possibly for specific

---

[4]  Although, with today's very low real interest rates, SOC estimates may be as low as 6%, as in the 2016 figure for New Zealand (NZ Treasury 2016).

[5]  OMB (1992) also notes that, rather than discounting at 7%, "Using the *shadow price of capital* to value benefits and costs is the analytically preferred means of capturing the effects of government projects on resource allocation in the private sector.  [But] … To use this method accurately, the analyst must be able to compute how the benefits and costs of a program or project affect the allocation of private consumption and investment.  OMB concurrence is required if this method is used in place of the base case discount rate."

[6]  This is discussed in Appendix B.  A working group commissioned by the Netherlands Government (Werkgroep discontovoet 2015), recommends an RFIR as a proxy for STP with, in addition, a substantial risk premium.

kinds of regulation, as illustrated above for the US. The Australian Victoria State guidance (Department of Treasury and Finance 2013) adopts a simpler, dual approach.

**Pragmatic regimes:** Some bodies face institutional constraints on promoting a formal analytical framework. The World Bank, as an example, has for the appraisal of proposed projects long specified a real rate of 10% or higher.[7]

Recent decades have seen a trend towards the use of lower social discount rates.[8] This will have been due in part, as noted by CEA2017, to the long term decline in real interest rates, and perhaps lower growth prospects, which could affect both STP and SOC regimes, and partly because of the wider adoption of STP discount rates.

Much of the discounting literature in the past two decades has been driven by long term climate change, where STP is the dominant paradigm.

## 3.      The core SOC versus STP arguments

### 3.1.     Basic rationales

The SOC approach starts from the premise that the annual percentage real rate of return to public investment should be no less than the rate of return from the money being left in the private sector. The social discount rate is therefore derived from market data, usually as a weighted average cost of capital. The STP approach, in contrast, starts from the premise that the weight given by government to future marginal income should be based on how much the welfare from marginal income declines with income growth and also how much the current population cares about future populations' marginal welfare. In contrast to SOC discount rates, an STP discount rate does not incorporate any opportunity cost of public funding (OCPF), which therefore needs to be handled, where necessary, by other means.[9]

The view of SOC advocates is well summarised by H&J2015 as follows. $\omega$ is the percentage rate of return foregone by taking money for public investment from private investment and personal incomes. SPIF is the Shadow Price of Investible Funds, to be applied to dollars of public investment to make them commensurable with dollars of consumption:
*"We … consider as close allies those who [like H&J] opt for a weighted average discount rate of ω with a SPIF of one, and those who opt for a [STP] discount rate of r with a SPIF of ω/r. The real enemies of sound economics are those who press for the use of low discount rates like r, without due recognition of the costs entailed when forgone investments would have had rates of marginal productivity much higher than r."*

This has much sense but oversimplifies some issues. The second sentence is sound in that users of STP discount rates too often forget that public spending should be given more weight than consumption. This is serious although, as explained in section 4.3 below, less catastrophic than it may appear. The first sentence assumes that the opportunity cost of a

---

[7]    Although in its backroom analytical work the Word Bank may adopt STP rates (e.g. Lopez 2008).

[8]    This trend is well summarised by a leading advocate of the SOC approach in Harrison (2010) (p 12).

[9]    In the early literature both SOC and STP advocates focused on the opportunity cost of public <u>capital</u> spending. Subsequently STP advocates came to see the issue more in terms of all public spending, but in practice public capital and current spending are in both discounting regimes treated the same way. They may handle public revenue, if at all, differently as discussed in section 3.2 below.

dollar of public spending can be approximated by the value of a constant annual flow \$$\omega$ of consumption benefits.  The present value of such a flow, discounted at $r$, is $\omega/r$.  As H&J imply, discounting the costs and benefits in a CBA at $r$ and multiplying the public investment costs by $\omega/r$ may, for many realistic project time profiles, give results similar to those from simply discounting the costs and benefits at $\omega$.

The need for some form of SPIF was recognised in the 1960s exchanges on SOC versus STP.  The consequent requirement in CBA for both a discount rate and a shadow price is presentationally and operationally complicated to apply.  The SOC paradigm, using one instrument for both time preference and opportunity cost, is much simpler to apply.  Unsurprisingly SOC dominated as governments adopted discounted cash flow techniques in the 1960s and 70s.[10]

SOC advocates mostly see the market data on which the SOC rate is based as at least adequately incorporating any social time preference.  While from an STP perspective the SOC paradigm is an approximation for CBA and not well suited to choice of technique analysis.  This paper addresses these surprisingly challenging differences.

## 3.2.    Some common ground …

SOC and STP advocates generally recognise clearly the distinction between general time discounting and changing absolute values over time (e.g. for outputs such as environmental benefits, which may increase in real unit value over time).  Both approaches normally work in real as opposed to nominal values.  And most regimes apply a common discount rate to nearly all cases.

Harberger (2007) introduced into the SOC paradigm the concept of the marginal dollar of taxation as "a necessary supplement … [to] … the conventional [SOC] assumption of capital market sourcing".  This distinguishes between projects that are self-financing, say by user charges, and those that are not.  It assumes that, with no cost recovery, a project would accumulate debt, and tax is raised to recover the financing of this debt over the project lifetime.  This tax raising would incur an OCPF, described in Harberger (2007) as the shadow price of public funds, in the sense used in this paper and in the STP paradigm.

While the SOC world has been slow to recognise public revenue as a form of 'negative public spending', some STP regimes still treat such revenues as transfers.  But In a well developed STP regime, as discussed later, dollars of user charges in a CBA would be handled in the same way (with the opposite sign) as dollars of public spending.

The marginal social cost of taxation (and hence of public funding) is now generally derived in the wider literature by estimation of the 'triangles' of lost consumer and producer surplus arising from taxes.  This approach gives costs typically in the region of \$1.2 to \$1.3 per \$1 of

---

[10]    In those early days practical application tended to mimic private enterprise investment appraisal, using a discount similar to, for example, a gross-of-tax corporate commercial rate of return.  This was easy to present, especially in the context of investment by publicly financed enterprises.

taxation. [11] SOC advocates would argue that the opportunity cost of public funding (OCPF) is normally higher than this, but so too would many STP advocates, following Feldstein (1997).[12]

Another field in which many practitioners of both paradigms might agree is the basic mechanics of public finance. Public spending in developed economies is generally funded mainly via some form of consolidated fund, funded in turn mainly by taxes and borrowing. Distribution at the margin between tax and borrowing is generally handled in practice as an issue of macroeconomic management, which can be assumed in microeconomic analysis to be competent, so that, in this context, the social costs of marginal dollars of taxation and of borrowing are for practical purposes near enough equal.

Related to this is the distinction between capital and current public spending. The distinction is central to public expenditure planning and management. But this is separate from the question of whether the social cost of funding $1m of public capital spending (or overspending) differs from that of funding $1m of public current spending (or overspending). In the STP literature there is no difference.[13] In the SOC literature the issue is less explicit, but appears to be seen in a similar way. A thoughtful paper cited with approval by B&Z2011 (Sjaastad and Wisecarver 1977) implies (p 516) that public capital and public current spending have the same opportunity cost: "there can be no doubt that current public expenditure must be charged not only with current consumption forgone but also with unrealized potential future consumption due to displacement of current investment in other sectors."

It is widely accepted across both discounting paradigms that discounted present values of costs and benefits, while often central to the analysis, are rarely the last word. There will generally be other significant, non-monetised factors to feed into decision making.

## 3.3.    ... but two separate literatures

### 3.3.1.    Background

In the early literature the focus of both paradigms was on the displacement by government of private investment that would have earned a rate of return higher than the STP rate. B&Z2011 cite Marglin (1963), as a leading early proponent of STP discounting, who developed qualitatively the principle of combining an STP social discount rate with a shadow price (>1) (H&J's SPIF) for public investment.

---

[11]   This is not to dismiss the value of this work, of which the impressive book by Dahlby et al (2008) is a widely cited example. Its analysis is relevant to applications such as the comparison of fiscal regimes across federated states. Dahlby et al uses the term 'marginal cost of public funds'.

[12]   Feldstein uses the term 'deadweight cost of tax changes' (i.e. OCPF − 1).

[13]   Early CBA literature focused on the comparison of public capital spending with later consumption benefits, with little attention to public operating costs. This may have led to some cultural intuition within economics, now fading, that dollars of capital and current public spending are more different than the really are. Sometimes today a government may, for self-discipline of borrowing, tie its borrowing to its capital spending. But even then it may still be reasonably assumed that marginal taxation and marginal borrowing have similar social costs.

B&Z2011 note that, today as in the 1950s and 60s, "While the SOC is conceptually straightforward, it is empirically challenging to arrive at a reliable estimate; not only must rates of return on alternative sources of funds be estimated, so must the proportions of funding drawn from each source". Thus the focus of SOC literature is on the effects of public fundraising on the economy and the sophistication of this analysis has developed substantially.[14,15]

From an STP perspective Feldstein (1970) noted, for the first time in the literature, that many applications of social discounting are to 'choice of technique' analysis (CoTA) and that *in these cases the opportunity cost of public funding was generally unimportant*. However that paper, discussed further below, had little if any immediate practical impact.

It was only in the 1980s and 1990s that the STP approach began to gain traction in some administrations. This may have been largely because social discounting was increasingly extending beyond CBA of capital projects to wider areas, often to 'choice of technique' analysis (CoTA), where the SOC framing seemed less intuitively powerful. It may have been partly because of the increasing use by public agencies of off-budget, direct private financing of public services (another example of CoTA). Such off-budget financing may be, in the view of some finance ministries, excessively encouraged by the implication, in the SOC approach, that the social costs of public and private capital financing are much the same. The arrival of climate change (and nuclear decommissioning and waste storage) as very long term policy concerns has reinforced the use of STP.

B&Z2011 note in this context that Weitzman (2001) surveyed professional economist opinion of the appropriate social discount rate for long term benefits and the responses lay predominantly in low single figures.[16] However B&Z2011 (pp 11-12) cast serious doubt on the validity of this work as a basis for public policy and many STP advocates would share these doubts. This Weitzman exercise (in contrast to his separate exposition – Weitzman 1998 – of the analytical case for rates that decline over the long term) seems unlikely to have materially influenced any government views on discounting.[17]

In recent decades STP literature and practical application has largely abandoned direct estimation of the opportunity cost of public funding (OCPF). It is sometimes ignored and sometimes handled in a different, pragmatic way as outlined later below. Thus the focus of STP literature is now on the specification and quantification of the STP rate. Overlap with the SOC literature is minimal.

---

[14]  Harrison (2010) provides an outstandingly thorough, Australian exposition and analysis of the issues. H&J2015 provide a higher level, but full and clear exposition of current SOC thinking.

[15]  An approach sometimes promoted for social discounting is that the rate of return to a public investment should be no less than what would need to be earned by a privately financed investment of similar risk in a competitive market. It implies case-specific discount rates depending upon the project's level of (systemic) risk. However the main differences between the SOC and STP paradigms apply equally to this "private sector analogue" approach.

[16]  Harrison (p 11) records that Weitzman's responses from 2160 PhD economists had a sample mean at around 4% per year, a standard deviation of around 3%, a median of 3% and a mode of 2%, with a range of -3% to 27%.

[17]  However a more rigorous and wider ranging exercise (Drupp et al 2015) recently produced numerically similar results.

Current STP regimes may be fairly criticised for giving too little weight to the OCPF. SOC regimes may be fairly criticised for being too locked in to the perception that the OCPF can generally be handled satisfactorily by a social discount rate higher than an STP rate.

B&Z2011 justify the SOC approach as follows:
*"The SOC approach is justified by the straightforward principles of applied welfare economics – demand price measures marginal benefit, competitive supply price measures marginal cost, and adding up (i.e. dollars of benefits and costs are valued independently of to whom they accrue) (Harberger, 1971). The basic exercise is the extraction of resources from the economy, which displaces investment and stimulates saving and in an open economy attracts additional foreign funding. The discount rate should be consistent with choosing a project that is more productive over another that is less productive. The rate then must cover the productivity that is forgone as a consequence of displaced investment and the net-of-tax supply price of the newly induced savings and the marginal cost of incremental foreign funding. Any lower rate than the weighted average represented by the SOC will fail this test. Though one can find a number of ways to motivate lower rates, one cannot escape the penalty of ignoring the correspondingly higher social productivity of investment funds. Any higher rate will forego desirable projects."*

STP advocacy today would agree that public investment criteria "should be consistent with choosing a project that is more productive over another that is less productive". But, as illustrated below, it would seek to explain why an SOC social discount rate, despite its powerful intuitive appeal, often does not achieve this.

B&Z2011, as in H&J2015 three years later, illustrate how, if an OCPF is included in the STP approach, the STP and SOC approaches might be presented as equivalent. Few STP advocates would deny that in some cases, including perhaps most CBAs, the SOC approach and STP approach (combined with a plausible OCPF of perhaps around 2) will give a similar division of projects into those with positive and negative NPVs. But this is not the case for 'choice of technique' analysis (CoTA), or for very long term applications. The SOC and STP paradigms as now applied are in practice very different, in theory and in application.

The following two subsections discuss two areas in which the SOC and STP approaches differ especially widely. These are 'choice of technique' analysis and, less straightforwardly, the costing of risk.

### 3.3.2.  Cost benefit analysis versus 'choice of technique' analysis: the Feldstein simplification and the B&Z critique

As noted in section 3.3.1, Feldstein (1970) commented that many applications of social discounting are to 'choice of technique' analysis (CoTA). In Feldstein's words *"in an important special class of expenditure decisions the problem of evaluating the <u>social opportunity cost of funds transferred from the private sector can be ignored; in these cases only the social time preference rate is relevant"</u>* (emphasis added). The special class of decisions Feldstein described as *"the choice among alternative techniques of producing a given output when project expenditures are equal or proportional to the social costs of the*

*resources used.[18]  The most obvious examples include the degree of capital intensity, the planned durability of equipment, the timing of replacements and maintenance, the choice of fuels and materials, and other specific aspects of the choice of technique."*

Such analysis compares alternative time streams of public spending (or alternative time streams of consumption).  Cost benefit analysis (CBA/BCA), in contrast, compares public spending with consumption (or the consumption equivalent value of, for example, environmental impacts).  CoTA in at least some developed economies is very common, perhaps more common than CBA.  The fields of public policy, such as transport and environmental spending, where monetisation of the main consumption benefits is routinely feasible, are still fairly limited, and within those fields there are still often 'choice of technique' options to be compared.

Feldstein (1970) was followed by a wider discussion of circumstances to which the logic applied Feldstein (1973), but the issue attracted little more literature at the time.  The point was however made again, less clearly and more narrowly, in a wider ranging paper by Bradford (1975) and this, 40 years later, prompted a helpful response from B&Z2011.

B&Z2011 explain that *"Bradford (1975) argued that for projects whose costs displace investment in the same proportion as the benefits induce investment, the appropriate discount rate is the STP rate with no need to shadow price benefits or costs.  However, his result depends upon two critical assumptions."*  These two assumptions, and a third point made by B&Z2011, are recorded below verbatim and labelled A, B, and C to help subsequent exposition.  They raise issues that are conceptually surprisingly challenging:

(A) *"first, that the private sector behaves myopically so its saving is not governed by optimizing behavior but rather by a simple rule of thumb whereby a constant proportion of (disposable) income is saved independent of the rate of return; … "*

(B) *"second, that investments in the private sector are not feasible options for the government, because otherwise scarce resources should be invested in such projects rather than in any project that can pass muster only at the STP rate."*

(C) *"Even if private sector investments are off limits for the government, whenever there is public debt outstanding debt reduction is always an option and the rate of return on debt reduction is the SOC rate."*

Point (B) best illustrates the big conceptual challenge of the Feldstein simplification, which is that <u>whatever</u> assumptions are made about alternative uses or crowding out effects of public spending in year $t_1$, the same assumptions can generally be applied to public spending in any future year $t_2$.  So if it were realistic for the government to, for example, make available funds for the private sector to invest in a project in year $t_1$ that yielded 8%, it could do the same in year $t_2$.

A conceptual hurdle here may be an assumption, as follows, that Feldstein left unstated.

---

[18]  A clearer wording for this sentence might have been "… *the choice among alternative techniques of producing a given output, where the analysis is comparing alternative time streams of public expenditure.*"

When a private investment yields a return of, say, 8%, this means that it generates a cash flow with an internal rate of return of 8%. However Feldstein implicitly assumes that, as logic demands, the flow of benefit cannot continue to <u>grow indefinitely</u> at an exponential rate higher than the growth rate of the economy. Thus, if this cash flow is discounted at a discount rate higher than the growth rate, it will have a finite present value, as in Feldstein's simplification and in earlier work by Marglin and others. Moreover, in a developed economy, a conventionally derived social time preference rate will virtually always exceed the projected long term economic growth rate. (If it did not, there would be a case for using the projected growth rate as a social discount rate.)

To illustrate the point numerically, simplifying Feldstein's analysis, suppose that the opportunity cost of \$Xm of public spending were indeed the return that would be obtained from the private investment of \$Xm yielding 8%. And suppose that the present value of this return, discounted at an STP rate, $r$, were say \$1.75Xm. Then the net present value at $t_0$ of a cost of \$Xm in $t_1$ followed by a cost saving of \$Ym in $t_2$ would be $1.75\{-X/(1+r)^{t_1-t_0} + Y/(1+r)^{t_2-t_0}\}$. We do not know whether 1.75 is a good estimate of the opportunity cost of public funding (OCPF). However there is little dispute that, whatever the number should be, it can generally be assumed for practical purposes to be constant over time. Its value thus has no effect on the ranking of alternative options of this kind, with differing values of X and Y.

Thus Point (B) does not hold. The Feldstein simplification incorporates no constraints on what alternative uses could or would be made of marginal public funds. It notes only that, in general, what could be done in year $t_1$ could also be done in year $t_2$.

Point (A) above reflects Bradford's incomplete recognition of the generality of Feldstein's original argument. The impact of public expenditure on private saving and private investment is covered in Feldstein's exposition by variables denoted by $S$ ('the shadow price of one dollar of forgone private investment') and $p$ ('the proportion of public spending that would otherwise be invested [by the private sector]'). Feldstein's analysis assumes that $S$ and $p$ remain constant through time. He justifies this by suggesting that *"The factors which determine S and p – the social return on private investment, the incidence of taxes, the social time preference rate – are likely to remain constant or change only slowly. The resulting small changes in S and p would be of only second-order importance."* Thus the nature of private sector behaviour, myopic or otherwise, is relevant here only to the extent that it changes over time. As Feldstein suggests, such changes are likely to be of only second order importance. For practical purposes they are generally immaterial.

Point (C) further illustrates how far the STP and SOC approaches and perceptions have drifted apart. To STP advocates the social benefit of \$1 of debt reduction cannot be fully described by a percentage rate of return. They would see it as equal to the OCPF and to the present value (at the STP discount rate) of the net resources that a debt reduction would generate. The best assumption for the future will generally be that this value will be broadly constant over time.

### 3.3.3. Risk

Public sector appraisals face many categories of risk. Some, notably the following, should not raise contentious differences between the SOC, STP approaches:

a) *Non-project-specific risks, such as global catastrophe.* These are implicitly included in private sector and hence SOC rates and to some extent in 'risk free rates'. With an STP rate they generally need to be explicitly addressed.

b) *Project-specific or institution-specific risks of optimism in estimates of costs, technical performance, or demand.* Such risks will be reflected only weakly at most in an SOC social discount rate or in an STP rate. They need to be addressed in other ways.

But one aspect of risk on which the SOC and STP discount rates have historically started from different premises is the cost of variability risk.

SOC discount rates, to the extent that they include returns to equity financed investment, reflect to a significant degree the equity market risk premium. STP discount rates have historically included no such premium.[19,20]

There are here two issues.

a) Should an STP discount rate include an adjustment for the covariance of public sector costs or benefits with *income*, and if so how?

b) Should an STP discount rate be adjusted for the equity risk premium that private financing would require for a similar privately financed project?

These questions, which have appeared in the literature for many decades, are addressed in Appendix B, which argues that the answer to (a) is "yes", but that the magnitude of this effect is very small, and that the answer to (b) is "no".

SOC rates unequivocally incorporate a significant equity risk premium.[21] This accounts for most of the numerical difference between conventional SOC and STP discount rates. However this difference is less fundamental than the 'Feldstein simplification' noted above. That simplification would apply to 'choice of technique' analysis whatever assumptions were made about the opportunity cost of public financing or public funding.

# 4.    The opportunity cost of public funding

## 4.1.    Definition and measurement

It is uncontentious that funding a dollar of public spending costs the economy more than the loss of a dollar of consumption. SOC discount rates embed such a cost.[22] STP rates

---

[19]    Often cited in this context, as discussed in Appendix B, is the famous paper by Arrow and Lind (1970).

[20]    This is one aspect of a wider division between SOC and STP approaches, in the weight given to financial markets as a source of data for estimating social time preference.

[21]    It can be argued that the equity risk premium is not a net social benefit. It is a benefit to the supplier, a benefit to the investor but only as compensation for the cost of risk, and a cost to the consumer. It is thus not a lost net social benefit or opportunity cost. This does not undermine the SOC paradigm. But it does suggest the SOC rationale could more strictly be seen as being not about opportunity cost but about the direct social cost of public financing, with a broadly positive answer to question (b) above.

[22]    In the SOC approach, as noted above, this cost is often presented as if confined to public capital spending, but for simplicity the acronym OCPF is used here to refer to this or to wider public spending.

quantify time preference only, with no implicit relative weighting of public spending and consumption.

## 4.2.     The OCPF in the SOC paradigm

In the SOC paradigm the OCPF is conventionally framed in terms of the rate of return that would be yielded by dollars left in the private sector.  In the 1960s and 1970s this was often presented wholly in terms of the rate of return to business investment.  However, as CEA2017 records (drawing on B&Z2011) Harberger and others developed from the 1970s a 'blended approach', having regard to the diversion from pre-tax returns to private capital (benefits to business), post-tax tax returns (benefits to consumers) and foreign financing.  Public <u>revenue</u>, as already noted in section 3.2, is handled differently.

CEA2017 summarises, drawing in part on H&J2015, many problems facing such analysis, all of which are generally recognised and so far as possible addressed by SOC advocates and not rehearsed here.

There is however the wider question of the SOC paradigm's assumptions about the impact of public funding.  It was long ago suggested by Lind (1990, page S-16) that, by then, 'the crowding out [of private investment by public investment] … does not appear to be very important to the analysis of the social discount rate'.  This is of course partly met by the inclusion now in the SOC approach of foreign financing and impacts on individual saving, but the assumed impact on business investment is still strong.  On the other hand the SOC approach does not incorporate many other distortionary effects of taxation to fund public spending.

## 4.3.     The OCPF in the STP paradigm

In the early STP literature the OCPF is seen essentially as the present value of lost benefit streams that, in the SOC paradigm, are expressed as a rate of return.  The Canadian STP advocates mentioned in section 1 propose a 'shadow price of capital' for any flows in or out of private capital generated by the public project or policy being appraised (Moore et al 2013a, 2013b).  But both these concepts seem to miss wider impacts of public funding.

A more fundamental approach is to define the OCPF simply as <u>the present value of the lost consumption arising from all the effects of marginal taxation</u> (or government debt).  The OCPF is then the factor by which dollars of public spending would have to be multiplied to make them commensurable with dollars of consumption.

The estimation of such a figure has not in recent years attracted academic interest.  Indeed, as noted in section 3.2, the dominant academic approach to estimating the cost of marginal taxation has been solely from the supply and demand elasticities of goods and services, which consistently gives "low" values of 1.2 to 1.3.  This, as outlined by Feldstein (1997), excludes many important but less direct and longer term impacts of increased taxation, such as the distortion of business remuneration and location policies and enhancement of the tax avoidance industry. [23]  This means that, with an STP discount rate, NPVs are misleading for

---

[23]     A ratio of 1.2 to 1.3 is much lower than that implied by SOC discount rates, when these are applied to the time profiles of typical public investment projects, and by the BCRs that are typically required for project

CBA, because they add together dollars of public and private spending as if they were equivalent. Some STP practitioners overlook this. That this can happen is a serious weakness. It is however not catastrophic for two reasons.

One reason is that, in at least some government administrations, much or most appraisal is 'choice of technique' analysis, where (because of the Feldstein simplification) the OCPF is unimportant.

The other reason is that, with cost benefit analysis, the issue can be largely resolved by estimating BCRs rather than NPVs. In practice aggregate budgets are normally set by high level political processes[24] so that, in comparing projects, the agency's budget constraints will typically mean that project approval requires a BCR significantly higher than one. This does however need a public expenditure control system that

− acknowledges the OCPF, so that a BCR of 1 will generally be seen as poor value;

− recognises that, given the uncertainties about the precise value of the OCPF and about project specific costs and benefits, and the presence usually of important non-monetised factors, there is no universal BCR value defining a sharp boundary between good and poor value.

# 5. Concluding summary

## 5.1. The status quo

The SOC and STP paradigms for social time discounting now diverge widely. Debate within finance ministries and in the literature about the fundamental methodology of social discounting (in contrast to the continuing development of the separate paradigms) has advanced very little in the past forty years. Some mutually inconsistent positions are entrenched. Within each paradigm there are issues on which there may never be a wide consensus. However on both sides of the wider SOC/STP debate some fundamental analytical and practical issues are persistently misunderstood.

## 5.2. Analytical foundations

Points (1) to (4) below are some of the foundations for the microeconomic appraisal of public spending or regulatory interventions. Most are normally, in practical application, tacitly assumed (or rejected). Points (5) and (6) are two of their practical implications. Point (7) addresses a related, enduring academic debate.

---

approval in an STP regime. However it is sometimes suggested that the high values for the OCPF implied by public sector capital budgets may arise largely from enduring government myopia or political short termism, and hence underinvestment, as opposed to perceptions of the social cost of taxation. In today's state of knowledge this cannot be empirically demonstrated or dismissed.

[24] In most developed economies total public spending, and the setting of agency budgets, while influenced by quantitative estimates of the agencies' costs and benefits, is ultimately a political process, determined by many drivers. Observed BCRs of approved and rejected proposals may therefore give some indication of the government's perception of the OCPF, but in practice it is unlikely that a finance ministry would ever see BCRs as a determinant of total spending, or as a strong determinant of agency allocations.

1. The distinction between capital and current public spending is important, and public spending agencies generally have separate capital and current budgets. But in a developed economy the social opportunity cost of $1 of public funding (OCPF) does not depend on the dollar's accounting classification. The cost of funding $1 of public capital spending is the same as that of funding $1 of public current spending.

2. The balance between government borrowing and taxation is generally determined as an issue of macroeconomic policy, so that for microeconomic analysis the marginal social costs of extra taxation and extra borrowing can normally be taken to be near enough the same.

3. The OCPF is a stream of lost consumption, distributed over future years. It can be quantified as percentage rate of return, or as a present value (discounted at the STP rate). This stream of lost consumption may continue in perpetuity, but it cannot increase indefinitely at a growth rate higher than the growth rate of the national economy. It follows that, provided the STP rate exceeds the expected long term economic growth rate (as will virtually always be the case), the present value of the OCPF is finite.

4. A value of the OCPF that was robust enough for use in general policy and project appraisal would make public expenditure commensurable with consumption. All impacts could then be discounted at an STP rate to produce NPVs. But no such estimation of the OCPF is currently feasible. It can however generally be taken as a working assumption, as noted by Feldstein (1970), that the OCPF will be constant over time.

5. It follows that in 'choice of technique' analysis (CoTA), where public spending is typically being appraised against future public expenditure savings (or consumption increases being appraised against consumption losses) the STP rate is appropriate for time discounting, with no adjustments for the OCPF.

6. STP is also appropriate for time preference in cost benefit analysis (CBA/BCA), where public spending is being appraised against benefits valued in terms of consumption. However, because of the OCPF, dollars of public spending carry more weight than dollars of consumption. A sensible mechanism for incorporating the OCPF in this case is to rank options by their benefit cost ratios, in which case the OCPF emerges by default via the political setting of high level aggregate budgets. The SOC alternative of applying a higher discount rate and calculating NPVs will probably compare most CBA options adequately, but not CoTA options or very long term CBA options.

7. Financial economists have for many decades asserted that the debt and equity cost of financing a private sector activity (in a competitive market) reveals the social cost of public financing of a similar activity by government. But examination from a welfare economics perspective rejects this in the absence of plausible empirical or analytical evidence. The freedom of equity markets that makes them crucial to a market economy brings with it, from the large and very visible fluctuations, a cost of risk that is absent with public financing.

## 5.3.    Operational conclusions

Government offices responsible for setting public discount regimes face conflicting academic theoretical mindsets.  They also face the need to devise and maintaining a regime that not only takes account of both time preference and the OCPF, but is also simple enough to be applied reliably across a diverse range of users.

As a pragmatic approach to handling these issues, in a context of exceptional political constraints, the US Office of Management Budget (OMB) has stood out as a thoughtful and structurally sophisticated, if rather muddled example.[25]  The long term government borrowing rate, which is a far from perfect, but politically fairly uncontroversial as a rough estimate for social time preference, has been specified for choice of technique analysis.  An STP rate of 3% has been specified for regulatory appraisal of impacts on consumption.  For CBA, where public spending is being compared with consumption benefits, 7% has been specified, presented in SOC terms.  But there is the proviso that if an agency wishes and has the capacity to apply a more sophisticated methodology, such as using a government borrowing rate as a discount rate and an extra weighting for public spending relative to consumption, it may do so with case by case OMB approval.

Other institutions mostly adopt either an STP-type regime (based on the Ramsey equation or, less satisfactorily, on risk-free market rates), or an SOC regime.  In STP regimes the OCPF may be overlooked in CBA/BCA.  While the SOC approach is not appropriate for 'choices of technique', which in many governments is common, or for social discounting over very many decades.

The UK Treasury, facing fewer institutional constraints than the OMB, specifies an STP regime that appears to have evolved to a form that often takes satisfactory account of the OCPF in CBA by focusing on benefit cost ratios, where the denominator is net spending from the relevant constrained budget and the numerator is the net consumption value of everything else.

Academic studies often suggest, with a numerical illustration, that the SDR is crucial.  It is important, but big investment mistakes arise overwhelmingly from perverse political priorities, or large errors in judgement about costs and benefits, not from poor choices of discount rate.  And a variation of two or three percentage points may have no significant effect on the level of a nation's public capital spending and very little effect on the actual choices made.

However the conceptual basis of the rate does deserve serious attention, both for its effect on discount rate values and for the scope that separating time preference from the OCPF offers for appraising special situations, as exemplified in Appendix B.  The most serious obstacles to progress are usually not those of data or quantitative analysis, but the institutional/behavioural challenges of achieving enough common understanding of the basic concepts to move towards an operational consensus.

---

[25]    As noted earlier this applies to the US OMB regime prior to 20 January 2017, when OMB guidance was removed from the White House website.

# References

Arrow, K.J. and R.C.Lind (1970) *Uncertainty and the Evaluation of Public Investment Decisions*, The American Economic Review, 60.3, 364-378

Atkinson, G., S. Dietz, J. Helgeson, C. Hepburn and S. Häkon (2009) *Siblings, not triplets: Social Preferences for Risk, Inequality and Time in Discounting Climate Change, Economics,* The Open-Access, Open-Assessment E-journal, No. 2009-26, June 10, 141–169

Bradford, D.A. (1975) *Constraints on government investment opportunities and the choice of discount rate*, American Economic Review, 65.5, 887-889

Burgess, D.F. (2013) *Reconciling alternative views about the appropriate discount rate*, Journal of Public Economics, 97, 9-17

Burgess, D.F. and R.O. Zerbe (2011) *Appropriate discounting for benefit-cost analysis*, Journal of Benefit-Cost Analysis, 2(2), 1-20

Burgess, D.F. and R.O. Zerbe (2013) The most a*ppropriate discount rate*, Journal of Benefit-Cost Analysis, 4(3), 391-400

Council of Economic Advisers (2017) *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate*
https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf

Cropper, M., S. Aydede and P. Portney (1994) *Preferences for Life Saving Programs: How the Public Discounts Time and Age*, Journal of Risk and Uncertainty, 8: 243–265

Dahlby, B. (2008) *The Marginal Cost of Public Funds: Theory and Application,* Cambridge, MA: MIT

Department of Treasury and Finance (2013) *Economic Evaluation for Business Cases: Technical guidelines*, State of Victoria

Dietz, S., C. Gollier and L. Kessler (2015) *The climate beta*, Working Paper No. 215, Centre for Climate Change Economics and Policy

Drupp, M., M. Freeman, B. Groom and F. Nesje (2015) *Discounting disentangled*, Working Paper No. 195, Centre for Climate Change Economics and Policy, University of Leeds and London School of Economics

Feldstein, M.S. (1970) *Choice of technique in the public sector: A simplification*, The Economic Journal, 80, pp. 985-990

Feldstein, M.S. (1973) *The Inadequacy of Weighted Discount Rates*, for a then forthcoming volume of essays in honour of Richard A Musgrave, reproduced in Layard (1972)

Feldstein, M.S. (1997) *How big should government be?*, National Tax Journal, 50.2, 197–213

Frederick, S. (2006) *Valuing Future Life and Future Lives: A Framework for Understanding Discounting*, Journal of Economic Psychology, 27, 667–80

Gollier, C. (2013) *Pricing the Planet's Future: The Economics of Discounting in an Uncertain World*, Princeton, NJ, Princeton University Press

Groom, B. and D. Maddison (2013) *Non-identical Quadruplets: Four new estimates of the elasticity of marginal utility for the UK*, Grantham Research Institute on Climate Change and the Environment Working Paper No. 121

Harberger, A.C. (1971) *Three Basic Postulates for Applied Welfare Analysis: An Interpretive Essay*, Journal of Economic Literature, 9(3), 785-797

Harberger, A.C. (2007) *Suggested new steps toward the practical implementation of cost-benefit analysis*, Paper presented at a Conference on Cost-Benefit Analysis, University of Washington, Seattle

Harberger, A.C and G.P.Jenkins (2015) *Musings on the Social Discount Rate*, Journal of Benefit Cost Analysis, 6.1, 6-32

Harrison, M. (2010) *Valuing the Future: the social discount rate in cost-benefit analysis*, Visiting Researcher Paper, Productivity Commission, Canberra

Joint Regulators Group (2012) *Discounting for CBAs involving private investment, but public benefit*, Joint Regulators Group, London
http://stakeholders.ofcom.org.uk/consultations/discounting-for-cbas/statement

Kolstad, C., K. Urama, J. Broome, A. Bruvoll, M. Cariño Olvera, D. Fullerton, C. Gollier, W.M. Hanemann, R. Hassan, F. Jotzo, M. R. Khan, L. Meyer, and L. Mundaca (2014) *Social, economic and ethical concepts and methods*, in 'Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change'

Layard, R. (ed) (1972) *Cost-Benefit Analysis: Selected Readings*, Harmondsworth, Penguin Books Ltd

Lind, R.C. (1990), *Reassessing the government's discount rate policy in light of new theory and data in a world economy with high degree of capital mobility*, Journal of Environmental Economics and Management, 18, pp S-8 to S-28.

Lopez, H. (2008) *The Social Discount Rate: Estimates for Nine Latin American Countries*, Policy Research Working Paper 4639, The World Bank

Lucas, D. (2014) *Rebutting Arrow and Lind: why governments should use market rates for discounting*, Journal of Natural Resources Policy Research, 6.1, 85-91

Marglin, S.A. (1963) *The Opportunity Costs of Public Investment,* The Quarterly Journal of Economics, 77.2, 274-289

Moore, M.A., A.E. Boardman and A.R. Vining (2013a) *More appropriate discounting: the rate of social time preference and the value of the social discount rate*, Journal of Benefit-Cost Analysis, 4(1), 1-16

Moore, M.A., A.E. Boardman and A.R. Vining (2013b) *The choice of social discount rate and the opportunity cost of public funds*, Journal of Benefit-Cost Analysis, 4(3), 401-409

NZ Treasury (2016) *Current Discount Rates*,
http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/currentdiscountrates

OMB (2016) *Cost-Effectiveness, Lease-Purchase, Internal Government Investment, and Asset Sales Analysis,* Not since 20 January 2017 readily available, but previously at
https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-05_0.pdf

OMB (Office of Management and Budget) (1992, 2015) *Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*: *Appendix C* updated November 2015 *https://www.wbdg.org/FFC/FED/OMB/OMB-Circular-A94.pdf*

Rees, M.J. (2003) *Our Final Century: Will the Human Race Survive the Twenty-first Century?* London, Heinemann

Sjaastad, L.A. and D.L. Wisecarver (1977) *The Social Cost of Public Finance,* Journal of Political Economy, 85.3, 513-548

van Ewijk, C. and B.J.G. Paul (2003) *How to price the risk of public investment*, De Economist, 151.3, 317-328

Weitzman, M.L. (1998) *Why the far-distant future should be discounted at its lowest possible rate*, Journal of Environmental Economics and Management, 36.3, 201-208

Weitzman, M.L. (2001) *Gamma Discounting,* The American Economic Review, 91.1, 260-271

Werkgroep discontovoet (2015) *Rapport Werkgroep Discontovoet*, Downloadable from
https://www.rijksoverheid.nl/documenten/rapporten/2015/11/13/rapport-werkgroep-discontovoet-2015-bijlage
Includes a seven page English Summary

# Appendix A.        The estimation of social time preference

## A.1.       Social time preference and market rates

Market prices in a competitive market are a preeminent indicator of public preferences and as measures of social time preference they have the great advantages of simplicity and observability.  The dismissal in H&J2015 of the conventional derivation of STP takes it as self-evident that the sound basis for its estimation is financial market data.  But such data do not provide a convincing measure of the extent to which a current population would wish to weight the marginal income of future populations.

Market rates can be strongly influenced by short to medium term government policy, for reasons unrelated to medium term social time preference for consumption, and by foreign demand for a nation's debt.  CEA2017 notes many other drawbacks.  Individuals routinely save and borrow at widely varying rates of return and interest.  Mortality may influence market rates more than social preferences.  Public project time horizons can be much longer than those of Treasury bonds.

There is also the fundamental issue, widely overlooked, that the <u>holding</u>, or failure to hold financial assets has value beyond the expected financial returns or financial costs.  Lower rather than higher stocks of financial assets reduce security and flexibility, to an individual or a nation.  Thus risk-free borrowing rates may be at best downwardly biased estimates, or lower limits, for social time preference, as seems to be supported by the empirical evidence.

## A.2.       The conventional estimation of social time preference

The estimation of STP from first principles conventionally considers two main components:

- the extent to which the population is (or perhaps should be) concerned about future populations' marginal utility.

- the extent to which future populations' marginal utility of consumption or income declines as per capita income increases over time.

These two components, discussed in turn below, appear in the Ramsey equation as STP = $\delta + \eta g$ , where $\delta$ is time preference for utility, $g$ is the growth rate of per capita income and $\eta$ the elasticity of marginal utility.  As a star in the early development of growth theory, the name of Frank Ramsey, who died in 1930 at the age of 26, deserves the fame brought by this use of the equation.  However it is sometimes (as in CEA2017) suggested that using the equation implies some particular growth model, with perhaps many associated restrictive assumptions.  But the STP paradigm normally has a more pragmatic basis.  The equation is a useful hook on which to hang an intuitively satisfactory way of constructing social time preference.  But its use in this way implies no restrictive assumptions beyond constant values for $\delta$, $\eta$ and $g$, except in special cases, where the equation may be further developed.

## A.3.       Social time preference for utility, $\delta$

This 'pure time preference' element is generally seen as the sum of small elements for risk and for declining social concern for the marginal utility of increasingly distant future populations.

On risk, Martin Rees, the UK Astronomer Royal, has written that *"I think the odds are no better than fifty-fifty that our present civilisation on Earth will survive to the end of the present century"* (Rees, 2003).  This assessment would imply a contribution to the SDR of 0.8% per year.  Practitioners might also consider two further risks.

- Severe adverse impacts that are unlikely to have been otherwise considered during even a well conducted appraisal – for example the premature, political termination of German nuclear power generation following the Fukushima tsunami.

- Income covariant risk.  This is discussed quantitatively in Appendix B, noting that, while presentationally significant, its effect appears to be very small.

Combination of these three factors suggests a premium in $\delta$ for risk of at least 0.5%.

On social concern for future populations, CEA2017 rightly records that "Expert disagreement over the pure rate of time preference is especially fierce".  Many academic authorities, sometimes with passion, see no ethical case for giving less weight to expected future marginal utility.  Economists in government tend to see the issue more in terms of estimating the informed preferences of the population they are serving.  This is generally taken to imply a slow decline over time as increasingly distant future populations command less empathy, but the empirical data are thin.[26]

Confusion can arise between general concern for others' marginal utility, where human preferences clearly favour those with whom people empathise more closely, and the 'rule of rescue', where typically all possible will be done to rescue anyone in immediate peril.  Issues such as the survival of civilisation have characteristics of the latter.  But the value of discounted cash flow techniques in such cases may be limited.

## A.4.  The decline in marginal utility of consumption as per capita income increases

The term $cu''(c)/u'(c)$, where $c$ is consumption and $u$ is utility, defines the *elasticity of marginal utility of consumption*.  And it is in this sense, with its sign changed to positive, that it is normally used, here denoted by $\eta$, in deriving an STP discount rate.

However the term is best known in textbooks as the Arrow-Pratt measure (or index, or coefficient) of *relative risk-aversion*.  It is also presented as an index of *inequality aversion* and as the inverse of the *elasticity of intertemporal substitution*.

These different concepts all have uses, but the relevance of each depends on the context.[27]  Human preferences seem too complex to justify a general assumption that a value derived for one concept provides a useful estimate for another.  The literature often presents the term in the STP context as a measure of risk aversion or of inequality aversion, implying

---

[26]  For many years studies of how much people said they cared about future utility impacts implied implausibly high pure time preference rates of several percentage points (e.g. Cropper et al, 1994). Frederick (2006) replicated these results and identified methodological flaws that explained them.  A more reliable study was too imprecise to provide a robust figure, though it would not have been inconsistent with zero.

[27]  Useful discussion of the first three of these uses is provided by Atkinson et al (2009).

some value judgement.  But practitioners appear mostly to see it as no more than a value-free estimate of the elasticity of marginal utility.

Many methods, of varying plausibility, with their own strengths and weaknesses, have been used to estimate $\eta$.  Some of the more plausible ones for use in an STP rate are well presented in Groom and Maddison (2013).  Estimates have generally converged over recent decades to values between 1 and 2.

# Appendix B. Other issues

This Appendix has five sections addressing: 1) Income covariant risk; 2) The equity market risk premium; 3) The very long term and climate change; 4) Appraisal versus public sector pricing (to which the SOC rationale is very relevant); and 5) Social discounting of project-specific private financing (as an example of a specialised application of social discounting, facilitated by the availability of a social time preference rate).

## B.1. Income covariant risk

The social benefits (and costs) of public interventions are often correlated with national income. The value of a given change in fatality risk, or an environmental impact, may increase as increasing per capita income increases people's willingness to pay for such benefits. Use of transport infrastructure increases as an economy grows.

The transformation of financial economics in the 1960s included the emergence of the Capital Asset Pricing Model (CAPM), which quantifies the return required on an investment as the sum of a risk-free rate and a premium arising from the general market risk and <u>the covariance of an asset's yield with that general market risk</u>. CAPM, as discussed in section B.2 below, is now widely used in analysis of the financing costs of activities that are at least partly equity financed. The late 1970s then saw developed of the Consumption CAPM (CCAPM), addressing <u>the covariance of an asset's yield with the investor's income or consumption</u>.[28]

In recent years there has been academic and practitioner interest in use of the CCAPM to estimate how the covariance of public service benefits with national per capita income reduces their welfare below that of their monetary expected values. This makes sense in principle, but CCAPM, like the mainstream CAPM, conventionally draws on <u>financial market</u> data including the equity risk premium, implying risk premiums of several percentage points for typical public policy benefits. But whether such financial market data are relevant to estimating the welfare impact of environmental, health, or other benefits of public policy is questionable.

Although correlations between public service impacts and per capita income can be strong the *covariances* are normally very small. Arrow and Lind (1970) dismissed the issue rather casually, with the observation that "It is sometimes argued that the returns from public investments are highly correlated with other components of national income through the business cycle. However, if we assume that stabilization policies are successful, then this difficulty does not arise."

---

[28] CAPM is usually expressed by the formula: $E(R_i) = R_f + \beta_i\{E(R_m) - R_f\}$, where $E(R_i)$ is the expected rate of return on capital asset $i$; $R_f$ is the risk-free interest rate; and $E(R_m)$ is the expected average market rate of return, so the term in curly brackets is the "market risk premium". $\beta_i$ (beta) is a factor equal to $cov(R_i, R_m)/var(R_m)$, relating the variability of the asset's returns to that of the market. $R_i$ may be defined in terms of the cost of equity finance alone or in terms of project risk: the latter, given debt as well as equity in the project financing, will have a lower beta. CCAPM is generally applied in a similar way, with beta being the covariance of the asset yield with the investor's income.

However covariances are not only low but, also in contrast to changes in equity yields, they are generally not consciously perceived as gains and losses. So there is good reason to value these variations by reference to a conventional function of utility against wealth or income. The discount rate premium in this case for costs or benefits that vary proportionately with per capita income is given by $\eta\sigma^2$, where $\sigma$ is the proportional standard deviation of the income growth rate.

Gollier (2013, Table 3.2) presents values of $\sigma$ for five developed countries for 1969-2010, ranging from 1.74% (US) to 2.21% (Japan). These figures, together with a range of values for $\eta$ of 1 to 2, imply a discount rate adjustment for such costs or benefits of no more than about 0.05% to 0.1%. Some impacts vary more than proportionally with income, but even if their percentage fluctuations were more than twice that of income this would still imply a discount rate premium of no more than about 0.1% to 0.2%.

Sometimes costs or benefits, especially in overseas development projects, are significantly correlated with the income of those affected, but not necessarily with income growth rates over time. For example a scheme may improve crop yields more in years of drought than years of plenty. But such case-specific impacts have historically been normally handled outside the discount rate.[29]

## B.2.     The equity market risk premium

Finance textbooks teach that the cost of (variability) risk of an activity is revealed by financial markets, as in CAPM as mentioned above. It is not uncommon for financial economists to start from this assumption when turning to publicly financed activity where there is no equity financing.[30]

A recent example, cited by CEA2017, is Lucas (2014). This makes many fair observations (including the fact that the focus of Arrow and Lind (1970) was largely about diversifiable risk, which is no longer a big issue), but misses the main reasons for doubting the relevance of equity risk premiums to most applications of public sector time discounting.

Fluctuations in equity markets, driven by economic changes and amplified by market sentiment, are very large.[31] They are also, as already noted, fluctuations of which the active equity investor will be aware. It does not seem surprising that investors' loss aversion takes equity market yields several percentage points above the risk-free rate, to much more than is implied by deriving the utility of the financial expected return from a plausible utility function ("the equity premium puzzle"). The freedom of equity markets is crucial to a capitalist economy, but the resulting fluctuations bring with it some cost.

---

[29]   Noting that the absolute amount by which the certainty-equivalent value of a monetised cost or benefit $C$ is reduced by its covariance with income $Y$ is given by $\delta C = \eta \text{cov}(C,Y)/Y$.

[30]   It is sometimes suggested, as a proposed *reductio ad absurdum*, that if public financing avoids the equity risk premium the government should be financing most or all of the economy. But experience shows that public financing heavily restrains private entrepreneurial initiative.

[31]   The UK FTSE 100 index fell by nearly 50% in 1999-2000 and by over 40% in 2007-2009. It is also, in real terms, significantly lower in early 2017 than it was thirty years ago, so any long term trend is very uncertain.

The covariance of public service benefits with income is in contrast generally small and those enjoying the benefits are generally not aware of the fluctuations. In this case there is no clear objection to using a plausible utility function to cost it, as in section B.1 above.

Moreover there appears to be no analytical explanation of how an equity risk premium could arise in a typical publicly financed project, such as for example a publicly financed, untolled road. The costs and benefits of such a project, after the initial investment, have a minimal effect on taxpayers. There is systemic variation in the benefits to users, but no evident reason why the welfare impact of this is should be more or less than that estimated from a conventional utility function.

Nonetheless market data, including the equity risk premium, are used by some governments for setting social discount rates. Netherlands practice is explained in van Ewijk and Tang (2003) and Werkgroep discontovoet (2015).

## B.3.    The very long term and climate change

Over the very long term there is a compelling case for applying a declining social discount rate, mainly because of uncertainty about the number.[32] If the present values of a dollar are calculated for ever more distant future years, the effective discount rate falls ever closer to the lower end of the plausible range of rates. (For example the present value of $1k, discounted over 100 years at 2% or 5%, is $138 or $8. If these were equally likely their average value of $73 would imply an effective discount rate of 2.6% – much closer to 2% than 5%.)

Very long term climate change analyses rarely if ever explicitly incorporate any OCPF. However these analyses are almost invariably 'choice of technique' analyses of alternative ways of obtaining given levels of climate mitigation or adaptation.

And even with climate change, with its long timescales, discounting perhaps receives disproportionate attention. The case for global action as fast as is achievable within the political constraints is clear to most impartial observers from real time projections, including their uncertainty, without discounting. Social discount rates matter more, as one of several factors, for comparisons of alternative technologies.

Climate change is a (modest) exception with respect to systemic risk (Gollier, 2013; Kolstad et al, 2014; Dietz et al, 2015). Dietz et al for example derive for projected, very long term variances in income and climate change impacts a relatively high discount rate premium of about 0.6%.

---

[32]    Netherlands guidance, while accepting this logic, mainlines a constant discount rate over time, partly for the plausible reason that interest rates, on which their SDR partly depends, are today exceptionally low and partly for the more debatable reason that "the same factor that causes the risk-free interest rate to fall could also explain an increase in the [market] risk premium", on which their SDR also depends (Werkgroep discontovoet 2015).

## B.4.     Pricing versus appraisal

An SOC framework, with its emphasis on capital markets, is appropriate for *pricing the output* of a government enterprise in a competitive market. It is also appropriate, and applied, to the regulation of private sector monopolies such as energy grids.

The comparison of pricing and appraisal regimes illustrates more generally the difficulty of maintaining analytical consistency in some political contexts. In the UK from the mid 1960s to the 1980s there were many public enterprises with specified appraisal discount rates and pricing regimes. The appraisal rate was for many years in high single figures (largely to meet finance ministry concerns to rein back demands for investment). But the pricing regime rates of return were in real terms in low single figures, or negative. Thus choice of technique decisions, such as engineering design, gave too little weight to future cost savings and prices were often set at inefficiently low levels, encouraging excessive demands for investment.

## B.5.     Social discounting of project-specific private financing

Private financing costs in social CBA are normally subsumed in the market price of privately supplied goods and services. They do however need to be explicitly addressed in two cases. One is where private sector bodies would be required to undertake significant investment to meet a proposed new regulation. The other is where financing alternatives are being compared, as for example in comparing the public and private financing of public infrastructure. The analysis of such cases is helped by the explicit recognition of social time preference.

The simplest approach to the first, regulatory case would be to ignore financing costs and to count only the capital cost of the new asset, as if it were publicly financed. A more complete approach is to estimate instead the private financing costs over the accounting life of the project and discount this cash flow at an STP rate. If the private weighted cost of capital (WACC) exceeds the STP rate this will of course give a social cost greater that the asset capital cost.[33]

The second case – comparing public with private financing of public infrastructure – involves three percentage rates: a public cost of capital, the private WACC and a social time preference rate. It is unlikely that any government could in practice maintain a regime incorporating all three rates, except perhaps for very special cases such as 'mega-projects'.

One simpler approach is to discount both the private financing costs (i.e. the cost stream to the public sector, or consumers in the case of user charges) and the capital spend in the public finance alternative, at a government borrowing rate. This would follow recent US OMB guidance. It was also advocated by UK Treasury accountants in the early 1970s, when the general discounting regime was SOC. Use of a government borrowing rate in this way will bias the comparison slightly against private financing, insofar as government borrowing rates are normally less than social time preference.

---

[33]    This technique is now used by UK regulators (Joint Regulators Group, 2012).

Another simple approach is to discount the private financing costs, and the capital spend in the public finance alternative, at an STP rate, which will typically be higher than the government borrowing rate.  This will bias the comparison slightly in favour of private financing.

A more rigorous approach, taking account of all three rates, would apply the logic described for regulatory analysis to both public and private financing costs, public debt financing costs being distributed over time in the same way as that assumed for the private financing costs.