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systematic risk**

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Government discounting controversies: changing prices, opportunity costs and systematic risk

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Abstract

The conceptual basis and numerical quantification of the time discount rate (or rates) to use for public sector analysis have been debated for over half a century. This paper addresses those aspects that are in principle amenable to formal analysis, with minimal need for judgements about ethics or administrative practicability. These include controversies, many of them very long lasting, about the discounting of quantities measured in the numeraire of marginal utility, about the opportunity cost of public capital and current spending, and about the relevance of equity risk premia to government appraisal. It is concluded that, while current UK government practice in these respects is sound, some positions that are still supported widely elsewhere do not stand up to close examination, but are likely to continue to be held as matters of faith.

1. Introduction

Derivation of the social discount rate to use in public sector analysis was a fashionable topic in the 1950s, 60s and early 70s. It came to prominence again in the late 1990s with the rising profile of very long term policy concerns, notably climate change and nuclear waste disposal. The Stern Review (Stern, 2006) stimulated a new peak of debate.

The emphasis has changed over the years. In the 1950s and 60s debate was dominated by argument about whether the rate should be a private sector “social opportunity cost” (SOC) rate or a separately estimated social time preference (STP) rate. The late 1960s saw debate about the relevance to social discounting of the revolution at that time in financial economics,¹ and this saw a further flurry in the UK around the turn of the century. From the mid 1990s a strong focus developed on discounting over the very long term. The Stern Review brought wider discussion than before of the ethical basis of the pure time preference parameter δ in the STP rate and of the possible ethical element of the parameter η that adjusts the STP rate for the effect of the expected increase in personal incomes over time.

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¹ That is the revolution building on the work of Markowitz on the 1950s, later developed especially by Sharpe and Lintner, and leading in particular to the capital asset pricing model (CAPM).

Some of the many still outstanding differences of view reflect at least arguably defensible differences in judgement about ethics, or the interpretation of empirical data, or the matching of instruments to targets, or administrative practicalities. Other differences arise from analytical misunderstandings. This paper focuses on analytical issues. Two parallel working papers address those issues with a material ethical component and those that are mainly issues of practical application.

This paper seeks specifically to

- further clarify some problems that arise when discounting quantities that are expressed in non-financial numeraires;
- dissect some old conflicts, including that of “SOC versus STP” and the relevance of equity risk premia to the social costs of public financing, that still prevail, but on which both sides appear to have given up listening seriously to the other.

The paper is written largely for economist readers, but will be accessible to anyone with an interest in these issues.

2. Changing prices and ‘valuation versus discounting’

2.1. Changing prices and values over time

It is uncontroversial among welfare economists that social discounting is generally best carried out in real terms, so that the discount rate itself does not include any element for general inflation and nor do the monetary valuations of the quantities to be discounted. This is government practice in most or all OECD countries.

It follows, again uncontroversially, that future prices before time discounting should include any expected *real* price changes. Real price increases over time might be expected in for example unit labour costs, or in the future social price carbon.

However confusion can arise when future relative changes in price or value are less immediately obvious. This can apply to impacts that are conventionally quantified not in terms of marginal income (or a numeraire such as public expenditure whose value maintains over time a broadly constant ratio to the value of marginal income), but in a numeraire that changes in real monetary value over time. One well documented example, discussed below, is that of quality adjusted life years (QALYs) in health economics, but the same problems arise with other such non-monetary numeraires.

QALYs, gained or lost from changes in health or mobility, are broadly speaking a measure of marginal utility, whose real monetary value therefore increases over time as income increases. This could be handled by increasing the monetary values of future QALYs over time, before discounting them at the standard discount rate. But explicit monetary valuation of the QALY is not straightforward and a short cut is to retain the QALY itself as the numeraire for these impacts, and to discount QALYs at a rate lower than the STP rate for consumption.

The current standard social discount rate in UK government is 3.5%, within which the pure time preference component (δ) is 1.5%. It would therefore, in the UK, be

sensible to discount QALYs at 1.5%. But the National Institute for Health and Clinical Excellence, following fairly widespread practice in health economics, has for some years discounted QALYs at the same rate as monetary costs (although it seems that this is now being rectified).

This illustrates, as summarised in Box 2.1, how difficult it can be for even distinguished economists to get their minds around the use of different numeraires in the same calculation.

Box 2.1 **Misunderstandings about discounting marginal utility**

QALYs are a measure of the marginal utility of (at least certain aspects of) a change in an individual's health state. So the real monetary value of the QALY increases over time, as per capita incomes grow. The argument for therefore discounting QALYs at a lower rate than financial costs has been well set out in the literature (Parsonage and Neuburger, 1992; Jones-Lee and Loomes, 1995; Gravelle and Smith, 2001). However it has not been widely understood within health economics. Thus in Claxton et al (2006) eight UK leaders in the field explain that discounting QALYs and costs at different rates cannot be right because, for a given expenditure today for a given future QALY benefit, the calculated £ per QALY will depend upon the reference date chosen for the discounting. This last observation is true since, over time, the real monetary consumption value of marginal utility rises while the real monetary consumption value of £1 of public spending stays broadly constant. Thus spending £10,000 today to save a QALY today is less good value for money (VFM) than will be spending £10,000 (in real terms) in year 10 to save a QALY in year 10, even though both cost £10,000 per QALY in the year in question.

A correctly calculated £/QALY provides a VFM comparator against spending in the reference date year for more QALYs in that year. Thus, for any two options, the proportionate difference in VFM is revealed if the expenditures and QALY benefits are discounted to *any* common reference date, even though the choice of reference date does affect the absolute values in £/QALY.

Claxton et al (2006) was followed by a well reasoned response in Gravelle et al (2007) and then a paper jointly authored by both sides of the debate (Claxton et al, 2011). This third paper acknowledged that under some assumptions (e.g. that the NHS budget constraint would increase over time so severely that the marginal social value of health spending, relative to consumption, increases as rapidly as the marginal value of utility) it might be acceptable to discount QALYs and expenditure at the same rate; but that this would entail "strong and implausible assumptions about values and facts".

The basic misunderstanding is not confined to the UK. For example Hammitt (2002), citing Gold et al (1986), notes that "it is generally considered appropriate to discount future QALYs at the same rate at which future monetary costs are discounted". This is sometimes explained in terms of an argument described as the Keeler-Cretin paradox (after Keeler and Cretin, 1983). This is that "if the costs of an intervention are discounted but the effects are not, then an intervention can be made to appear more favourable simply by postponing its implementation" (Hammitt, 2002, p988). This can be true under some conditions. People or enterprises may postpone spending on IT hardware, or on housing, or on shares or currency, because they believe the price of what they wish to buy will fall substantially in the future. But this is a sound choice *only* when the expected benefits of delaying spending until year t more than offset the disbenefits of not enjoying the good or service in years 0 to t , such as (in the case of the QALY) a patient's pain and suffering over the period during which treatment is delayed.

2.2. Valuation versus discounting

More generally in public debate, there is often confusion between the concepts of time discounting and the real time valuation of future impacts.

As illustrated above, most *physical* measures of environmental and health and safety impacts, such as risks of fatalities or illness, areas of environmentally valuable land, or species diversity, increase in real monetary value over time as personal incomes grow, and as perhaps they become scarcer. This is widely recognised, but sometimes combined with a failure to realise that discounting is normally applied to marginal *income*, or its equivalent, as opposed to marginal utility.

It can also arise from a correct perception that *intramarginal impacts*, such as world catastrophe, and aspects of other impacts such as species extinction, do not fit simply into the normal assumption of social discounting and of cost-benefit analysis (CBA) more generally that the analysis is being applied to marginal impacts.

And it can arise from an assumption that CBA claims to include in its costs and benefits monetary valuations of everything that matters, whereas most practitioners recognise that in real applications there are nearly always some important factors that cannot sensibly be monetised.

Little if anything in this list is contentious. These are however issues that might usefully be more often recognised and presented in the discussion and presentation of discounting, to put into context the ubiquitous illustrations of how exponential compounding or discounting expands or reduces exponentially.

3. Opportunity cost

The concept of opportunity cost, in the context of government discounting, arises in two related but distinct guises. One guise, uncontentious in principle, is as the opportunity cost of £1 or \$1 of public expenditure (OCPE), which attracts less serious research than it would seem to deserve. The other guise, more contentious, though rarely discussed as opposed to being asserted as obvious, is in the argument for the use of a commercial rate of return as a “social opportunity cost” (SOC) social discount rate: this is the focus of one of the most enduring dialogues of the deaf in applied economic literature and international public sector practice.

The usual ordering of discussion of these issues, perhaps reflecting the order in which they have emerge in the literature, is to first address the arguments surrounding the concept of an SOC discount rate and then, if at all, the opportunity cost (or shadow price) of public spending. An approach to more consensus among economists might be helped if the issues were differently framed, by looking first at the OCPE. I here initially follow the conventional ordering, but take a second bite at the SOC cherry after discussing the OCPE.

3.1. The “social opportunity cost” (SOC) discount rate

In the 1950s and 1960s there was much debate in the literature (e.g. Feldstein, 1964) about the case for a “social opportunity cost” (SOC) discount rate as against a “social time preference” (STP) rate. The traditional SOC argument is that the market shows the rate of return on private sector investment: so it is surely obvious that public investment should yield at least this return? This has an immensely strong intuitive and presentational appeal – so strong that its proponents generally see no reason to explain it formally or consider criticisms of what they see as obvious. It was influential in the setting of public sector discount rates in the UK until the late 1980s.

It remains influential in many countries outside Europe, and is still accepted by some influential economists.^{2,3}

This perception has however over the past two decades faded from serious debate in UK government and is currently rarely found in Europe. An STP rate is applied by the European Commission to the CBA of Structural Fund investment proposals (European Commission, 2008) (although the Commission, consistently if potentially confusingly, use a market rate for financial appraisal).

In an extraordinarily simple, perhaps one-person economy, there might be no difference between time preference and the cost of capital, as indeed is generally the case for commercial enterprises in a real economy. But for public policy or project analysis the market does not reveal society's time preference, for reasons including the following.

- 1) Private sector financial returns are measured in ways that differ substantially from social returns as measured in CBA. In particular they exclude consumer surplus (although this may for private investment often be small) and exclude positive and negative externalities.
- 2) Private sector financial returns typically include a return to equity which incorporates a significant equity risk premium. This is specific to the equity market and not relevant to public financing. (Although this is disputed by some financial economists as discussed in section 4 below.)
- 3) Given the flexibility and globalisation of financial markets it is unlikely that marginal public spending has for many years had any significant effect on the financing of private investment. This was noted by Lind twenty years ago, with the comment that "the crowding out [of private investment by public investment] that has been the focus of most of the closed economy models does not appear to be very important to the analysis of the social discount rate" (Lind, 1990, p S-19).
- 4) A variant of the SOC argument is that, rather than displacing private investment, public investment could replace private financing, and so obtain the same commercial return but without the cost of the equity risk premium. At an elementary level this argument has some substance, but in practice it is impossible to separate financing from management. The twentieth century demonstrated that a largely free market economy, based on equity and private debt financing, serves society much better than a centralised economy based on public financing. This generally applies as much to individual firms or projects (in competitive markets or regulated utility markets) as it does to the economy in general.

There is another argument that also looks to market rates of return to indicate how society should compare costs and benefits over time. This is that such rates reveal people's personal time preference as investors or borrowers. In this case commercial

² A rather special case is Nordhaus, who appears to agree that the social discount rate should be based on the concept of social time preference, but whose climate change models incorporate the assumption that markets are so perfect that the STP rate is equal to the financial rate of return on private sector investment. (Nordhaus's critique of the Stern Review's handling of discounting is otherwise, in my view, essentially sound).

³ A variant not further discussed here is the concept of an SOC/STP weighted discount rate. This is comprehensively and severely criticised in Feldstein (1973).

investment rates of return would need to be reduced substantially because of the tax wedges between these returns and returns to investors. But the huge diversity of real rates of return at which people save and borrow, from negative to well into double figures, casts little light on the value even of personal time preference, which may anyway be a poor indicator of social time preference.

However before further discussion of the SOC approach to discounting the following section discusses the opportunity cost of public expenditure.

3.2. The opportunity cost of public expenditure

To the extent that public spending displaces private investment there is an opportunity cost. But this cost is measured not by a *rate* of return, but by the present value (at the STP rate) of the flow of net benefits (including consumer surplus) that the private investment would have generated. This has long been recognised, as for example in Feldstein (1964), and never formally challenged. It is a fundamental flaw in the SOC discount rate argument.

However the opportunity cost of public expenditure goes well beyond direct impacts on private investment.

3.2.1. The opportunity cost of capital and current expenditure

In the 1950s and 1960s it was widely supposed that public *capital* spending had an opportunity cost of more than one, relative to private consumption, on the grounds that it displaced private sector capital. The opportunity cost of public current expenditure was rarely considered.

The distinction between capital and current spending is important in public and private sector expenditure planning, accounting and expenditure control. However public expenditure on labour and materials to build a capital asset is generally no more nor less a burden on the taxpayer than public expenditure on labour and materials to provide maintenance or other services. In the UK, as in many developed economies, both will generally be funded ultimately from a consolidated fund. And the balance between taxation and borrowing is an issue for *macroeconomic* optimisation. A competent government adjusts the levels so that, at the margin, the social costs are equal.⁴ Thus, for *microeconomic* analysis of marginal central government spending, the macroeconomic and wider social impact of the taxation needed to fund the spending (i.e. the distortions and the diversion of resources from the private sector) should normally be the same for all public expenditure.

However a specially high opportunity cost for public capital spending, relative to public current spending, is sometimes assumed even today. For example Cline (1999) suggests a special shadow price for public capital of spending 1.5, apparently for displaced private investment. Boardman et al (1996) also suggest a higher

⁴ At least in countries where the central government has sufficient power to achieve this. Conventions such as the golden rule, that changes in government borrowing should over the cycle be confined to the level of net investment, may affect the borrowing/taxation balance. And some public projects are financed directly by private capital. However competent macro management still equalises the marginal social costs of borrowing and taxation.

opportunity cost for capital. More explicitly Dasgupta (2008, p 156) proposes that capital spending has a higher opportunity cost than current spending because the social time preference rate is typically below the productivity of capital. But there is no good reason why the impact of public spending on the wider economy should depend upon its accounting classification.

3.2.2. Valuing the opportunity cost of public expenditure

Raising an extra £1 of taxation (or correspondingly foregoing £1 of public revenue, say from fees or tolls) imposes a combination of costs and opportunity costs which typically have a value of more than £1 of consumption. These define the marginal social cost of taxation or of public funds, often described for simplicity as the opportunity cost.⁵

This cost includes the marginal administrative cost of tax collection and many impacts on consumer, employee and corporate behaviour (including impacts on private investment). Arguably also relevant are political perspectives, such as the ethical arguments against taxation; and its potentially beneficial impacts on distribution (Sandmo, 1998). Feldstein (1997) made a strong but unrewarded plea for more empirical work on the distortionary impacts of taxation. He estimated, mainly from analysis of the large reduction in US marginal income tax rates between 1985 and 1988, that marginal taxation should be given a shadow price of 2 or more. He noted that the common textbook assumption that a tax increase will reduce aggregate demand, with some consequent fall in tax revenue, does not apply in practice, because other instruments are used to maintain demand; but that many *supply* impacts, and distortions in the distribution of demand, are usually overlooked or underplayed.

Ruggeri (1999), although largely concerned with the relative impacts of different types of taxation, reviews the literature and suggests, on the basis largely of Canadian data, shadow prices of only around 1.2 to 1.3, but this omits some behavioural responses considered by Feldstein. A subsequent World Bank Working Paper (Warlters and Auriol, 2005) records a wide range of mainly earlier literature and derives for African countries shadow prices of again only around 1.2.

Another approach to the shadow price is to examine how governments weigh consumption benefits against public spending in setting budgets for activities such as roads or flood protection, where most of the benefits can be monetised. In the UK this would imply a ratio almost certainly greater than 1.5, and perhaps a factor of 2 or 3, or even higher: Defra reported a target benefit/cost ratio of 5 for their Flooding and Coastal Change capital programme, for the 2007 Comprehensive Spending Review (Defra, 2011). However this evidence is not clear cut as investment decisions are usually influenced by other, non-monetised costs or benefits such as negative environmental impacts, and some capital programmes may be seen as of politically low priority.

⁵ While opportunity cost is sometimes used as a synonym for social costs of any kind, a distinction between opportunity cost and direct cost might in this case be helpful. In practice most of the costs imposed by taxation, over and above directly displaced consumption, are direct costs arising from market distortions. But the term opportunity cost in this context has endured.

In the UK public sector the concept of an opportunity cost of public expenditure has been explicitly recognised (with Treasury approval) in the websites of the Department for Transport (DfT) and its Scottish equivalent:

“The BCR [benefit-cost ratio] should also take account, in principle, of the distortionary impacts of general taxation on the economy. This principle, known as the Social Opportunity Cost of Exchequer Funds or SOCEF, or more generally as the Marginal Social Cost of Public Funds (MSCPF), might imply a 30% uplift to expenditure costs. Applying the SOCEF criteria would mean that any projects or expenditure with a BCR of less than 1.3 would not be value for money.”. (Transport Scotland, 2009)

Australian Federal Government Guidance (Department of Finance and Administration, 2006, p 37) cites an estimate by Campbell (1997) that “the marginal excess tax burden for general taxation in Australia [is] around 25 per cent of revenue raised”.

An explicit shadow price for public spending might be applied directly, as a multiplier of more than unity. However administrators and ministers might be sceptical of economists insistence that the money units in their expenditure budgets should be multiplied by some insecurely based factor before they are used in policy or project appraisal. Alternatively public expenditure could be retained as the numeraire and a multiplier *less* than unity applied to quantities measured in units of consumption, as are most benefits in CBA. This would be administratively easier than applying a shadow price to public spending.

In practice the opportunity cost of public expenditure is handled in the UK and in most public administrations implicitly, by requiring CBA benefit cost ratios usually well above unity for any project to be approved. This means of course that the denominator of the ratio should be net public cash flow: that is spending minus revenues. This is now broadly the case in the UK Department for Transport (although it has been decided that the denominator should be net cash flows to the DfT budget). But there is no UK departmental-wide standard.

3.3. The SOC discount rate revisited

As noted above a fundamental flaw in the SOC discount rate argument is that the opportunity cost of any displaced private investment is measured not by a rate of return, but by the present value (at the STP rate) of the flow of net benefits that the private investment would have generated.

One implication of this is that when public sector discounting is applied to choice of technique – that is to the comparison of alternative patterns of spending for essentially the same benefits – any opportunity cost of public spending applies equally to all of the expenditure figures. It has no effect on the benefit cost ratios nor the relative NPVs of the alternative options. The opportunity cost of public expenditure is thus in these cases irrelevant. This was long ago set out clearly, and without challenge, by Feldstein (1970).

However in practice the STP concept is sometimes acknowledged, but set aside on the pragmatic grounds that a high discount rate helps to adjust for capital rationing. Both of the examples quoted here are from documents published in the 1990s, which are however still current. Their age illustrates the difficulty of changing official guidance in this field.

- The World Bank’s Handbook on Economic Analysis of Investment Operations (Belli et al, 1998) records that
 “The Bank traditionally has not calculated a discount rate but has used 10-12 percent as a notional figure for evaluating Bank-financed projects. This notional figure is not necessarily the opportunity cost of capital in borrower countries, but is more properly viewed as a rationing device for World Bank funds” (Technical Appendix, paragraph 20).

In their backroom analysis (as illustrated in Lopez, 2008) World Bank economists appear to be firmly committed to STP.

- The US Office of Management and Budget specifies *government borrowing rates* as discount rates for Cost-Effectiveness, Lease-Purchase, Internal Government Investment, and Asset Sales Analyses. For other investments and regulations it specifies a default value of 7%. It explains the latter as being because public projects “displace both private investment and consumption” and qualifies it as follows.

“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. 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.” (Office of Management and Budget, 1992, section 8.b(3))

Sometimes the same logic is applied more crudely. For example the UK Treasury in 1989 adopted regimes that led to a discount rate of 8% for the nationalised industries (initially, but not subsequently explained in terms of SOC, Hansard, 1989) and 6% for the public services (on the basis of STP).

Sometimes it is claimed that a discount rate higher than STP is for practical purposes a satisfactory way of allowing for the opportunity cost of public expenditure, but this does not fit the facts well. Boscolo et al (1998), writing about climate change, quote references supposedly showing that “the shadow price and the weighted average methods generally yield equivalent results in terms of the ranking of alternative projects”. As an example they assume an STP rate of 1.5% and an SOC rate of 10%, combined with a shadow price of capital of approximately 2, which they suggest is well represented by a weighted average discount rate of about 8%. But, as illustrated in Table 2.1, for these particular assumptions, this equivalence applies to only a narrow set of circumstances: in this case for discounting periods, of around $t=10$ years.

Table 3.1
A weighted discount rate as an adjustment for a shadow price of capital

	Discounting period, t years:	0	10	20	30	50	100
(i)	0.5 x PV at 1.5% discount rate, £	50	43	37	32	24	11
(ii)	PV at 8% discount rate, £	100	46	21	10	2	0.05
	Ratio of (ii) to (i)	2.00	1.07	0.57	0.31	0.08	0.004

Row (i) shows the present value in year 0 of £100 spent in year t, discounted at 1.5%, and then multiplied by 0.5 to make it commensurable with the unspecified initial investment of £K, with its shadow price of 2. Row (ii) shows the present value of the £100 discounted at the weighted average discount rate, using the assumptions of Boscolo et al.

There is however one aspect in which an SOC rate of return is relevant to public sector discounting, but as a constraint. This applies because some of the economic

benefits from private sector investment can reasonably be assumed to grow over the long term at the growth rate of the economy. (They cannot grow more rapidly, or they would eventually exceed GDP.) Thus the present value (when discounted at the social discount rate) of the benefits of private investment displaced by public spending can be assumed to be finite only if the social discount rate is higher than the longer term rate of growth of GDP. This means that the applied STP rate must not be less than the expected long term rate of growth of GDP. This is not a constraint that would bite in any developed economy, but it might possibly do so in an economy with a medium to long term prospect of low per capita income growth and high population growth.

This constraint is rarely noted in the literature. The fact that long term economic returns to investment cannot exceed the GDP growth rate is made by Rabl (1996), who interprets this however this as defining a *maximum* rate for social discounting over the long term. This appears to follow from his assumption that (although he quotes the Ramsey equation and suggests numbers of its components) the social discount rate follows from traditional SOC, which was probably the case in his native French government at that time.

None of this is to say that private sector rates of return are irrelevant to the financial control of public enterprises. They are irrelevant to discounting, but there is a case for applying such rates to *pricing* in markets where the private sector might also contribute. It was perverse that, for the UK nationalised industries, it was historically normal for the financial rates of return from their revenues to be much *lower* than the discount rate that the industries were required to apply to choice of techniques in their procurement, and far below private sector rates of return. This will have led to general overinvestment because prices were too low, but underinvestment in cost saving design measures because the discount rate was too high.⁶

4. Efficient markets and the government discount rate

The “efficient market hypothesis” (EMH) approach to public sector discounting proposes that government discount rates should include a risk premium equal to the premium that the equity market reveals for the private financing of a similar activity.

It is uncontentious that, in a competitive market, equity risk premiums measure a cost of “systematic risk” – that is the risk of volatility that is correlated with the equity market average volatility and so cannot be diversified away. Some financial economists believe that financial markets are so efficient that this premium must be measuring an inherent social cost of the activity being financed. Thus if the activity is financed by public debt or taxation this makes little or no difference: the cost of systematic risk revealed by the equity premium if it were privately financed is still there (Brealey et al, 1997; Grout, 2003).

⁶ This sad state of affairs is not replicated in the UK public service trading funds, which are given a “required rate of return on their *total* assets. This may lead to their using a higher than STP rate for many appraisals, but for a decision involving very substantial expenditure they would generally be expected to apply a conventional CBA (STP) discount rate.

In practice advocates of the EMH approach appear generally to accept that the systematic risk associated with public expenditure *costs* is usually very low. These costs therefore, in this approach, should be discounted at the risk free government borrowing rate (which is normally lower than estimates of the rate of social time preference). However the discount rate for consumption benefits should be derived as the sum of the risk-free rate and a risk premium equal to the equity market average risk premium multiplied by a factor (beta) reflecting the correlation between the expected commercial return to a comparable privately financed investment and the market average risk premium.⁷

Many benefits and costs of public service activities are correlated with fluctuations in GDP, but the covariances are too small to impose any significant social cost or benefit.⁸ It is in any case hard to see, in the case of a publicly financed investment, such as for example a new road, exactly how an “equity risk premium” cost could arise, or on whom it might fall. The mechanics of how such a social cost of risk would arise from a publicly financed activity are never explained by advocates of the EMH framework.

Welfare economists generally regard the average equity risk premium as a function mainly of equity markets themselves. Thus, while equity markets are crucial to market economies, they are subject to, for example, fads or fashions among investors, and to largely mean-reverting impacts from factors such as oil crises, wars, business cycles, or indeed financial crises.

In the 1960s and early 1970s these opposing views were argued among the heavyweights. An early exchange on the implications of the EMH for publicly financed activities was a critique, by Bailey and Jensen (1972), of arguments made by Arrow (1965, 1966) that the cost of risk may be lower for government than for the private sector. The still widely quoted paper by Arrow and Lind (1970) developed these arguments, commenting for example, in contrast in particular to Hirshleifer (1966), that “many insurance markets do not exist” and on “clear evidence that the existing capital markets are not perfect”. They conclude that the cost of *GDP-covariant* variability with public financing is negligible. The two sides appear subsequently to have tacitly called a truce and it is no longer an issue of high level debate. However Arrow and Lind (1970) continues to be attacked by EMH proponents in some UK literature (e.g. Klein, 1997). The arguments deployed, such as the fact that per capita benefits of non-rival goods (such as national defence) do not diminish as they are more widely spread, are concisely presented by Currie (2000), with a response to each in Spackman (2001).

⁷ This method of calculation describes the capital asset pricing model (CAPM). CAPM is often applied to company stock, in which case beta (the covariance of the stock’s return and the market average return divided by the variance of the market average) measures the stock’s volatility in relation to the market. In the context of investment appraisal beta is derived from the expected *project* returns, either as an equity beta or as a (generally lower) project beta when gearing is taken into account.

⁸ Arrow and Lind (1970) presented this as self evident, given that sensible macroeconomic policies would continue to prevent extremely large fluctuations in GDP. Spackman (2001) shows that ‘generous’ assumptions about relative risk aversion, the covariance of public sector costs and benefits with GDP and the uncertainties of forecasting UK GDP over the latter half of the 20th century might justify a discount rate premium of 0.15 percentage points.

Several developments support the welfare economist's scepticism about equity markets being so efficient that they reveal a hidden cost of public debt or tax financing. In the 1990s distinguished commentators such as Wadhvani (1999) set out, before the general market downturn, reasons why the market appeared at that time to be overvalued, which in the EMH view of the world cannot happen except perhaps very briefly.⁹ A parallel finance literature, made more widely accessible by Mandelbrot and Hudson (2004), develops models of financial markets based on fractal analysis, showing that equity market fluctuations are very different from the Gaussian distribution generally assumed in financial economics. This is reinforced in *The Black Swan* (Taleb, 2007), which well forecast some key features of the financial collapse in the following year. Wadhvani (2008) suggests that, leading up to the financial crisis, "a common thread running through many of the policy mistakes is a belief in the Efficient Markets Hypothesis".

CAPM is a valuable tool that gives good service in many contexts, such the setting of price controls for regulated industries. But there does not appear to be an analytical case for supposing that equity risk premiums have any material relevance to social discounting.

5. Conclusions

The bullet points below summarise and in some cases slightly expand the main points from sections 2, 3 and 4. These are followed by some more general observations.

5.1. Changing prices and 'valuation versus discounting'

- Social discount rates specified by governments for use in policy and project analysis are generally defined as time preference rates for marginal consumption or income.
- They are most often applied in practice to public expenditure. However it is uncontentious to assume that the time preference rate for marginal public spending or taxation is the same as that for consumption or income.
- Sometimes social discounting is applied to quantities whose real monetary unit value is changing over time. This presents no problem if the quantities being discounted are valued in terms of their expected future real monetary unit values. An example of a unit value increasing over time is the social price of carbon specified for public sector analysis in UK government.
- Some impacts are measured in units that can reasonably be regarded as measures of marginal utility. An example is small changes in risks of death or illness. Other examples include environmental impacts such as changes in air quality.

⁹ For example successive editions of the leading textbook by Brealey and Myers (e.g. 2003, pp 563-4) say that "managers generally favour equity rather than debt after an abnormal price rise. The idea is to catch the market while it is high. ... But *we know that* the market has no memory and the cycles that financial managers seem to rely on do not exist." (*emphasis added*)

- In these cases, rather than adjusting their future, increasing valuations and discounting at the standard social discount rate, an alternative is to discount them directly at the pure time preference rate for marginal utility. This can be a useful short cut, but it needs to be used with care as it can easily lead to confusion.
- In public debate, there is often confusion between the concepts of time discounting and the real time valuation of future impacts, It is sometimes argued, for example, that potentially catastrophic impacts or other environmental impacts should be discounted at specially low rates, where the reasons proposed relate to the valuation of such impacts rather than to the social discount rate.

5.2. Opportunity cost

- The traditional “social opportunity cost” (SOC) argument that the government discount rate should be equal to the commercial rate of return on marginal private sector capital investment is mistaken in several major respects. In particular the opportunity cost of any private investment displaced by public investment is given by the present value of the consumption that it would have yielded, not by a rate of return; commercial returns do not measure social returns; and the opportunity cost of public expenditure extends far beyond the effects of directly displaced private investment. A common use of the government discount rate is in any case to compare alternative public expenditure cost streams, in which case the opportunity cost of public expenditure is irrelevant.
- The traditional SOC argument has however powerful intuitive appeal and presentational simplicity. Some governments still base their discount rates on this approach. Some other institutions use the argument to justify high rates imposed for pragmatic reasons, such as capital rationing or because users cannot be trusted to apply an adequate opportunity cost to public expenditure relative to consumption benefits.
- The taxation ultimately required to fund public spending imposes significant costs. £1 of public spending thus has a social cost, usually described as an opportunity cost, of more than £1 of personal consumption.
- This opportunity cost does not depend on the accounting classification of the spending: it applies equally to public capital and public current expenditure.
- Most of the empirical literature on this opportunity cost proposes a premium of 25 or 30 per cent. However it can plausibly be argued that these studies take too limited a view of the impacts of taxation. UK government rationing of expenditure, in particular the weighting given to public expenditure relative to consumption benefits, has for many years implied that the premium is more than 100 per cent.
- The traditional SOC argument would however have merit in the extreme case where a discount rate derived from the Ramsey formula was lower than the expected future rate of GDP growth. This might possibly occur in a country with a large population growth rate and low growth in per capita income. In that case the GDP growth rate would be the appropriate rate for government discounting.

5.3. Systematic risk and efficient markets

- Many of the costs and benefits of publicly funded activities are subject to variability that is correlated with fluctuations in income, in particular GDP. However the welfare cost of this systematic variability is generally negligible because the proportionate fluctuations of national income are very small, relative in particular to those of equity markets.
- However it is not uncommon for financial economists to assert that, in government appraisal, consumption benefits should be discounted at a rate that includes the premium for systematic risk that would apply to a similar equity or part equity financed private investment producing a similar output.
- This argument is based on a strong faith in the efficient markets hypothesis and is never supported by an explanation of how, with public financing, such a risk premium could arise or on whom it would fall. It is nonetheless influential in the setting of government discount rates in some countries.

5.4. General observations

The objections to using a market rate of return as a social discount rate on “opportunity cost” grounds (the SOC approach), or on the grounds that the equity risk premium measures a cost of risk that cannot be avoided by public financing (the EMH approach), are extremely persuasive. However these objections are never challenged, except by assertion, or by arguments that do not address the point at issue, and there is no early prospect of the issues being clearly resolved within the economics profession.

The standing of the SOC approach has however faded somewhat in recent decades. Casual observation suggests that its proponents are predominantly from among those who first learned their economics before the 1980s. It may therefore continue to fade.

The EMH approach is younger and perhaps continues to be the natural assumption of new generations taught on leading financial economics courses. It seems unlikely that it will ever be accepted by many economists experienced in welfare economics. But it may continue to influence governments where actual or one time financial economists hold senior official or politically influential positions.

Some of the same considerations apply to the discounting of marginal utility at the same rate as marginal income. This is unquestionably wrong. But, in the context of the QALY, it sometimes continues to be promoted. It seems that in the UK a firm line taken by one health economics expert, over many years, is at last yielding some results, in the literature and in the practices of the health authorities. But elsewhere the error seems likely to persist.

If a sound basis for deriving the discount rate for public policy and project analysis is not provided by market returns to capital, a rate needs to be derived from first principles. Most or all governments that use a rate based on first principles, including the UK, adopt the Ramsey formula $STP = \delta + \eta g$, where δ is pure time preference for marginal utility, η is the elasticity of marginal utility (with sign reversed) and g is the

growth rate of personal incomes. Valuation of the parameters δ and η is discussed in a parallel paper.

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