# Accounting for the Timing of Costs and Benefits in the Evaluation of Health Projects Relevant to LMICs

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October 2017 Review Draft

Guidelines for Benefit-Cost Analysis
Working Paper No. 8

Prepared for the Benefit-Cost Analysis Reference Case Guidance Project
Funded by the Bill and Melinda Gates Foundation

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# Accounting for the timing of costs and benefits in the evaluation of health projects relevant to LMICs

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*Working draft. Co-authorship of the complete and final methods paper TBC*

*I wish to acknowledge participants of the BMGF funded workshop on discounting on 14th September 2017 for their insightful presentations discussion of topics that have informed this draft. However any errors, omissions and misrepresentations are entirely the responsibility of the author*

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**Summary**

The history of changing and sometimes conflicting recommendations about discounting policies, especially for health projects, arise from alternative normative positions taken and different judgements about the empirical questions that follow.

When it is believed to be important to explicitly quantify other impacts of a project beyond measures of health and public health expenditure, it is appropriate to convert all effects into time streams of the equivalent consumption gains and losses, while reflecting the opportunity costs and shadow prices of existing constraints. These time streams can be discounted at social time preference for consumption.

This approach avoids embedding multiple augments in the discount rate for health, health care costs and consumption. The separate and explicit accounting for these arguments allows clarity about the quantities that need to be assessed, available evidence to be identified and used transparently and consistently, while preserving the possibility of accountable deliberation about evidence, values and unquantified arguments in decision making processes.

**Purpose**

The intention is to offer practical clarity about principles, the key assessment required and the evidence currently available to inform them, so that decision makers in LMICs, as well as global bodies and other stakeholders, are better placed to judge what would be an appropriate discount policy in a particular context. The primary focus of this paper is to offer practical guidance on appropriate analysis of time streams of the costs and benefits of an intervention used in a particular context, where key quantities are likely to differ; setting out what type of evidence would be relevant, what is currently known that is relevant to low and middle income settings and how this evidence might be strengthened. This includes how global bodies, which make recommendations (e.g., WHO), purchase health technologies (e.g., Global Fund) or prioritise the development of new ones (e.g., BMGF), should judge the value of projects in many different settings where appropriate discounting of costs and benefits are likely to differ. The BCA reference case specification will need to balance a desire for comparability between the evaluation of policies and projects relevant to very different contexts while encouraging the use of bespoke discounting policies which will be more relevant to specific contexts. One important way to achieve all these ends is report results in an extensive way with an explicit and accountable assessment of key quantities so that discounting procedures do not embed multiple arguments but expose the key assessment required. This also enables the impact of alternative, but plausible scenarios to be explored and the analysis to be updated as better estimates of key quantities evolve.

## 1 Conceptual framework

A decision to introduce a policy (e.g., public health, educational, environmental etc.) or provide an effective intervention (e.g., a health technology or programme of care for a particular indication) for the current population may offer some immediate health benefits but, in many circumstances, the health benefits will occur in future periods. Other projects are intended to reduce the risk of future events for the current population and others may also reduce risks for future incident patients, so the health benefits they offer will not be fully realized for many years. Future benefits are not restricted to health but may also include impacts on private consumption opportunities, other forms of public expenditure and social objectives of particular interest to the decision maker. Similarly, different policy choices and projects will not just impose health care and other costs in the current period but in future periods as well.

The question is how account should be taken of when heath care and other costs are incurred and health and other benefits are received. In part this depends on the normative question of whether social welfare can be fully specified and ought to be founded on the type of compensation tests which underpin most BCAs or whether economic analysis should not attempt to prescribe social choice but inform decision making processes based on narrowly defined but explicitly stated objectives (e.g., to improve health in CEA). Although many of the key quantities are common to both normative positions, important differences include the interpretation that can be placed on their results; whether or not the net effects are best expressed as measures of health, health care resources or consumption and therefore how each of these types of effect might be discounted.

The conceptual framework associated with these two alternative normative positions is set out in Section 1.1 and 1.2. The often complex reality of multiple sectors is initially simplified into two (collective health care expenditure and private consumption) to illustrate principles and key quantities that follow, which are common to high as well as LMIC settings. How these principles can be extended to reflect a more complex reality of multiple sectors is then discussed. The evidence available to assess the key quantities that follow from these principles in LMIC settings are set out in section 2.

### 1.1 The objective of the project is to improve health

This normative position views decision making bodies and institutions as the agents of a principal (e.g., a socially legitimate process such as government) which allocates resources and devolves powers to the agent, giving it a responsibility to pursue specific, measurable and therefore narrowly defined objectives that are regarded as socially valuable, e.g., improving health. In these circumstances economic analysis cannot be used to make claims about social welfare or the optimality or otherwise of the resources allocated to health care. Its role is more modest, claiming to inform accountable decision making, revealing the implied values and exposing the implications of social choices made by the principal. It is this role that economic analysis has tended to play in

health policy and underpins much of the evaluation of health care projects and cost-effectiveness analysis (CEA) that has been conducted (Drummond et al 2015, Coast et al 2008).[1]

### *1.1.1 Why discount health?*

In this context the reason to discount future health effects cannot appeal to preferences and the type of welfare arguments that underpin the Ramsey Rule, but instead to the opportunity costs of financing health care. The health care costs of a project could have been invested elsewhere in the economy or used to reduce public borrowing at a real rate of return, which would provide more health care resources in the future and generate greater health benefits. Health care transforms resources into health so from the perspective of a social planner trading health care resources over time is to trade health. Therefore, if health care costs are discounted to reflect the opportunity cost of financing health care, their health effects must be discounted at the same rate.[2] If the social planner in health care cannot directly invest in the private sector the opportunity cost they face is the rate of return on debt reduction rather than higher estimates of the opportunity cost of capital based on market rates (Spackman 2017). For example, real yields on government bonds reflect the marginal cost of increasing health care expenditure available to government (Paulden and Claxton 2012; #Paulden 2017#). In this context the broader question of the social opportunity costs of public expenditure including the macroeconomic choice of levels and mix of taxation and borrowing (Spackman 2017) can be regarded as the responsibility of government rather than spending departments or national and supra national decision making and advisory bodies.[3]

### *1.1.2 Representing the effects projects*

Estimates of the additional health care costs ($\Delta c_h$) and additional health effects ($\Delta h$) (e.g., measured as Quality Adjusted Life Years, QALYs, gained or Disability Adjusted Life Years Averted, DALYs) of a project or a health care intervention are commonly presented as incremental cost-effectiveness ratios (ICER).[4] These provide a useful summary of how much additional resource is required to achieve a measured improvement in health (the additional cost per QALY gained or DALY averted). Whether the intervention will improve health outcomes overall requires a comparison with a 'threshold' ($k_h$) that reflects the likely health opportunity costs, i.e. the improvement in health that would have been possible if the additional resources required had, instead, been made available for other health care activities. A project will improve health overall if the additional health benefits exceed the health opportunity costs associated with the additional health care costs that must be found from existing commitments or use additional expenditure that could have been devoted to other health care activities ($\Delta h > \Delta c_h/k_h$).[5]

Most projects offer a time stream of health effects ($\Delta h_t$) and health care costs ($\Delta c_{ht}$) which can be reported as either time streams of health effects, health care resources or consumption (see Table

[1] See Drummond et al 2015 Section 2.4.3 pages 33-38

[2] This is commonly illustrated by a comparison of terminal and present values. The cost per QALY of a project with immediate costs and additional health benefits all occurring at a future point in time is the same whether costs are expressed at their terminal value when the health benefits occur, or discounting the health benefits back to their present value at the same rate (Nord 2011).

[3] See Drummond et al 2015, page 108-112

[4] See Drummond et al 2015, Section 2.4.1 page 27-31 and Section 4.2.1 page 79-83

[5] This is equivalently expressed as whether cost per QALY it offers is less than the cost-effectiveness 'threshold' ($\Delta c_h/\Delta h < k_h$), so long as the 'threshold' used to judge cost-effectives reflect the likely health opportunity costs.

1). For example, the additional health care costs each period can be reported as the health expected to be forgone ($\Delta c_{ht}/k_{ht}$) by applying an assessment of the health opportunity costs relevant to that period ($k_{ht}$) (see columns (4) and (5) in Table 1). These time streams of health gained and forgone can then be discounted at a rate which reflects a social time preference for health ($D_h$=$r_h$).

The normative position that (often implicitly) underpins much of the evaluation of health care projects, takes the values implied by the outcome of legitimate processes (e.g., government implicitly or explicitly determining collective expenditure on health care) as a partial but revealed expression of some unknown latent social welfare function that may include many conflicting arguments, e.g., health equity, social solidarity among many others that are difficult to specify let alone quantify (Drummond et al 2015). Similarly the social choice of how resources are devoted to health care over time and the resulting health in each period reveals something about society's willingness to trade current and future health, i.e., the choices of the principal in setting the level of health expenditure each period, based on expectations about how the marginal productivity of health care expenditure is likely to evolve, implies values for $k_{ht}$. Therefore, a revealed social time preference for health[6] can be based on the rate at which the principal can borrow or save ($r_s$) and whether the 'threshold' is expected to grow ($gk_h$) because this indicates the relative value (in terms of health care resources) of current compared to future health ($r_h = r_s - gk_h$) (Paulden and Claxton 2012; #Paulden et al 2017#).

Alternatively, rather than transform additional health care costs in to health losses in each period the health benefits can be valued as the additional health care resources which would have been required to deliver similar health benefits in that period by applying the relevant assessment of health opportunity costs to the health benefits ($k_{ht}.\Delta h_t$. see column (7) of Table 1). The time streams of health care resources gained and forgone can then be discounted at a rate which reflects the opportunity cost, faced by the principal, of increasing public health care expenditure, $r_s$, (e.g., real yields on government bonds).

[6] This is the time preference for health, as distinct from pure time preference (for utility) or STP for consumption (see 5 below).

**Table 1. Reporting the effects of a project with health benefits and health care costs**

| | Effects of the project | | Health Effects | | Equivalent heath care resources | | Equivalent consumption effects | |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Time | Additional health benefits | Additional health care costs | Benefits | Costs | Benefits | Costs | Benefits | Costs |
| 1 | $\Delta h_1$ | $\Delta c_{h1}$ | $\Delta h_1$ | $\Delta c_{h1}/k_{h1}$ | $k_{h1}.\Delta h_1$ | $\Delta c_{h1}$ | $V_{h1}.\Delta h_1$ | $V_{h1}(\Delta c_{h1}/k_{h1})$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. |
| t | $\Delta h_t$ | $\Delta c_{ht}$ | $\Delta h_t$ | $\Delta c_{ht}/k_{ht}$ | $k_{ht}.\Delta h_t$ | $\Delta c_{t1}$ | $V_{ht}.\Delta h_t$ | $V_{ht}(\Delta c_{ht}/k_{ht})$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. |
| T | $\Delta h_T$ | $\Delta c_{hT}$ | $\Delta h_T$ | $\Delta c_{hT}/k_{hT}$ | $k_{hT}.\Delta h_T$ | $\Delta c_{hT}$ | $V_{hT}.\Delta h_T$ | $V_{hT}(\Delta c_{hT}/k_{hT})$ |

Most analyses of health care projects generally report results as cost effectiveness ratios rather than net health benefits (column (4)-(5)) or the equivalent net effect on health care resources (column (6)-(7)) (Phelps and Mushlin 1991, Stinnett and Mullahy 1998). If the effects of a project are reported as an incremental cost effectiveness ratio ($\Delta c_h/\Delta h < k_h$) it must be compared to a single 'threshold' relevant to the current period ($k_{h1}$). However, some account must still be taken of expected changes in health opportunity costs. For example, if health opportunity costs are expected to grow in real terms ($gk_h>0$), because the marginal productivity of health care expenditure is expected to decline (e.g., due to real growth in health expenditure), then future costs are less important because they will be expected to displace (or any additional resources could deliver) less health. In some circumstances this can be achieved by discounting the additional health care costs at a rate that accounts for any growth in the 'threshold', reflecting the relative importance of future costs ($D_c = r_h + g_k$[7], and $D_h=r_h$) , i.e., a form of dual discounting which reflects expected changes in the marginal productivity of health care expenditure (Claxton et al 2011).

The widespread reporting of incremental cost-effectiveness ratios can be seen as an historic norm which may reflect reluctance on the part of decision making and advisory bodies to be explicit about how much society can afford to pay to improve health and how this is likely to evolve over time. Until recently there has also been a lack of evidence about the likely health opportunity costs (Culyer et al 2007). As a consequence implicit assessments have been embedded in how costs and health effects are discounted. This has contributed to a lack of clarity about discounting policy, what a cost effectiveness 'threshold' ought to represent and how it might be informed with evidence.

One key recommendation is that this and other forms of dual discounting should be avoided (see section 3.2). Although cost-effectiveness ratios might be a familiar and useful summary the primary analysis should report time streams of health benefits and health care costs (columns (2) and (3) in Table 1), and their transformation into streams of health effects (columns (4) and (5) in Table 1)

[7] This approximation is based on the plausible assumption that $r_h$ and $g_k$ are small.

and/or streams of equivalent health care resources (columns (6) and (7) in Table 1) based on an explicit assessment of health opportunity costs and its evolution over time (see Section 2.1 for a discussion of current evidence and possible default values relevant to LMICs).

It is also possible to express the effects of an investment which only has health effects and additional health care costs as the equivalent consumption value of the health gained ($V_{ht}.\Delta h_t$) and the heath forgone ($V_{ht}(\Delta c_{ht} / k_{ht})$) in each time period. To do so requires some assessment of the consumption value of health ($v_{ht}$) and how it is likely to evolve over time (see Section 1.2 for a more detailed discussion and section 2.3 for a brief consideration of available evidence). However, in these circumstances, where there are no effects outside health and the health care cost or where the social planer has decided that other effects should be set these aside when considering this type of health care project[8], the equivalent consumption value of health does not influence the decision as it simply rescales any net health benefit or net health loss (i.e., both sides of $\Delta h > \Delta c_h/k_h$ are multiplied by the same quantity). The key is that health care costs cannot be treated as if they are private consumption costs, because $k_{ht}$ and $V_{ht}$ cannot be assumed to be necessarily and always equal (see section 2.3 for discussion of theoretical reasoning and empirical evidence that suggests $k_{ht} < V_{ht}$ ).

<<TBC>>

- Only exclude consideration of k if know that k=v which requires evidence of k and v (see section 2.2.1) or an unrealistic assumption that that expenditure will necessarily and immediately increase to k=v if the project is adopted
- Broader question of increasing health expenditure?
    - need to know k and how k increases with budget
    - V provides useful information about whether and how much increase would be regarded as socially valuable, eg knowing that projects re being rejected that would have NPV>0 if k=v.

### *1.1.3 Non-health impacts and non-health care costs*

Projects often impose costs or offer benefits beyond measures of health and health care expenditure. For example, there may be out of pocket costs and/or net production effects of improved survival and quality of life (e.g., Meltzer 2013) as well as other social objectives of the decision maker (e.g., equity and financial protection etc.). Other types of project may have health and other effects but might not impose health care costs (e.g., nutrition, educational and environmental projects). Therefore, some implicit assessment of how other types of benefit and costs should be traded against health gains and health care costs is required in deliberative decision making processes.[9] When other effects include impacts on private consumption opportunities an explicit assessment of the consumption value of health (see Sections 2.2) allows health, health care

[8] There are reasons to set aside explicit and quantitative consideration of other effects if they are likely to conflict with other important social arguments that are difficult to specify let alone quantify, e.g., equity and the benefits of social solidarity offered by collectively funded health care. This is the explicit decision that has been taken in the UK by NICE and UK DH after considering the benefits and potential costs of quantifying these wider effects in the decision making process (refs Claxton et al 2015b and #Claxton et al 2010#).

[9] See Drummond et al 2015, Section 4.3.2.4 page 91-94

costs and effects on private consumption to be expressed as either, their health, health care resource or consumption equivalents. This is illustrated in Table 2a where the same investment which has health benefits and health care costs also imposes costs on private consumption ($\Delta c_{ct}$ ) or offers private consumption benefits (i.e., when $\Delta c_{ct}$ <0).

**Table 2a. Reporting the effects of a project on health, health care costs and consumption**

| | Effects of the pproject | | | Effects on heath | Effects on consumption |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Time | Additional health benefits | Additional health care costs | Consumption costs | Net health benefits | Net consumption costs |
| 1 | $\Delta h_1$ | $\Delta c_{h1}$ | $\Delta c_{c1}$ | $\Delta h_1 - \Delta c_{h1} / k_{h1}$ | $\Delta c_{c1} + k_{c1}. \Delta c_{h1}$ |
| .. | .. | .. | .. | .. | .. |
| t | $\Delta h_t$ | $\Delta c_{ht}$ | $\Delta c_{ht}$ | $\Delta h_t - \Delta c_{ht} / k_{ht}$ | $\Delta c_{ct} + k_{ct}. \Delta c_{ht}$ |
| .. | .. | .. | .. | .. | .. |
| T | $\Delta h_T$ | $\Delta c_{hT}$ | $\Delta c_{hT}$ | $\Delta h_T - \Delta c_{hT} / k_{hT}$ | $\Delta c_{cT} + k_{cT}. \Delta c_{hT}$ |

**Table 2b. Expressing the net effects of a project as consumption, health and health care costs**

| | Net effects | | |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Time | Equivalent consumption effects | Equivalent health effects | Equivalent health care resources |
| 1 | $v_{h1}(\Delta h_1 - \Delta c_{h1}/k_{h1}) - (\Delta c_{c1} + k_{c1}.\Delta c_{h1})$ | $(\Delta h_1 - \Delta c_{h1}/k_{h1}) - (\Delta c_{c1} + k_{c1}.\Delta c_{h1})/v_{h1}$ | $k_{h1}((\Delta h_1 - \Delta c_{h1}/k_{h1}) - (\Delta c_{c1} + k_{c1}.\Delta c_{h1})/v_{h1})$ |
| .. | .. | .. | .. |
| t | $v_{ht}(\Delta h_t - \Delta c_{ht}/k_{ht}) - (\Delta c_{ct} - k_{ct}.\Delta c_{ht})$ | $(\Delta h_t - \Delta c_{ht}/k_{ht}) - (\Delta c_{ct} + k_{ct}.\Delta c_{ht})/v_{ht}$ | $k_{ht}((\Delta h_t - \Delta c_{ht}/k_{ht}) - (\Delta c_{ct} + k_{ct}.\Delta c_{ht})/v_{ht})$ |
| .. | .. | .. | .. |
| T | $v_{hT}(\Delta h_T - \Delta c_{hT}/k_{hT}) - (\Delta c_{cT} - k_{cT}.\Delta c_{hT})$ | $(\Delta h_T - \Delta c_{hT}/k_{hT}) - (\Delta c_{cT} + k_{cT}.\Delta c_{hT})/v_{hT}$ | $k_{hT}((\Delta h_T - \Delta c_{hT}/k_{hT}) - (\Delta c_{cT} + k_{cT}.\Delta c_{hT})/v_{hT})$ |

Adopting an explicit consumption value of health ($v_{ht}$) allows costs and benefits beyond measures of health and public health expenditure to be included as a stream of consumption (column (4) in Table 2a). However, the net effect on consumption (in column (6) of Table 2a) also requires some assessment of the other (non-health) opportunity costs associated with additional health care costs (column (3)) and the health opportunity costs associated with them (column (5)). Therefore, once

other effects beyond health and health care costs are included, some assessment of either the consumption opportunity costs of health care expenditure ($k_{ct}$) or the consumption effects of changes in health is also required (whether they are gains, $\Delta h_t$, or opportunities lost, $\Delta c_{ht}/k_{ht}$)[10]. The net effects of the project on both health and consumption can then be reported as two time streams of net health and net consumption effects (columns (5) and (6)).[11]

Such estimates and explicit assessments enable the quantification and conversion of multiple effects to a common numeraire while reflecting evidence of likely opportunity costs and social values. This is illustrated in Table 2b where the net effects of the project (columns (5) and (6) in Table 2a) can be expresses as a time steams of equivalent net consumption effects (in column (2)); equivalent health effects (column (3)); or the equivalent health care resources (column (4)). Once the net effects on health and consumption of the project are expressed as equivalent time streams of consumption they can be discounted at STP for consumption ($r_c$) based on the Ramsey Rule.

### 1.2 The objective of the project is to improve welfare

Traditionally economic analysis (e.g., Boadway and Bruce, 1984) adopts a view of social welfare resting on individual preferences revealed through markets and their surrogates or modified by an explicit welfare function. Analysis based on this normative position (e.g., benefit-cost analysis) is less well represented in the evaluation of health projects, partly due to the difficulty of decision making bodies being willing to identify a welfare function carrying some broad consensus or social legitimacy, particularly if health is felt to be unlike other goods (e.g., Broome 1978, Sen 1979, Brouwer et al., 2008, Arrow 2012). Nevertheless, health must inevitably be traded with other welfare arguments, most notably consumption, by social planners whilst taking account of the constraints on health and other public expenditure they face.

This normative position regards purpose of any type project, including those that require health care resources, as improving a broader notion of welfare rather than health or other explicitly stated social objectives. If consumption and health are the only arguments or are separable from others then decisions which maximise the consumption value of health will also maximise social welfare (Gravelle et al., 2007). In this context the reason to discount future health effects can be based on preferences and the type of welfare arguments that underpin STP based on the Ramsey Rule. This provides a clear link between social time preference for consumption and health (Gravelle and Smith, 2001).

[10] These alternatives will be equivalent if the causal consumption effects of health care expenditure run only through the health effects of health expenditure, rather than, in part at least, directly from health expenditure itself. Insofar as health expenditure has a positive impact on economic growth compared to other forms of expenditure then restricting attention to the consumption effects of changes in health is likely to underestimate the consumption opportunity costs of health care costs.

[11] It should be noted that attempts to estimate and explicitly account for the consumption opportunity costs of health care expenditure are particularly limited, even in high income settings, but do exist (Claxton et al 2015b). Although there is currently little evidence in lower income setting to support such assessment some default assumptions based on what is already known about the relationship between changes in health and economic growth should be possible(see Section 2.2.2).

The relative importance of future health care costs and the consumption value of health gained and forgone can be reflected in the following ways which have different implications for discounting policy. The health benefits and costs of a project can be reported as a stream of expected health gained and forgone each period by applying the 'threshold' relevant to that period (columns (8) and (9) in Table 1). These health effects can be valued by applying a consumption value of health relevant to that period (columns (8) and (9) in Table 1). The time stream of the net consumption effects of the project can also be included (columns (6) in Table 2a) and the resulting time stream of equivalent consumption effects (column (2) Table 2b) can be discounted at a rate ($r_c$) which reflects a STP for consumption.

The alternative to this more extensive approach would be to try and account for changes in health (and other) opportunity costs and the consumption value of health through discounting. For example, for the project in Table 1 the discount rate for $\Delta h_t$ could be amended to reflect growth in the consumption value of health ($D_h = r_c - gv_h$) and the discount rate applied to $\Delta c_{ht}$ could be amended to reflect growth in the consumption value of health forgone and changes in the rate at which future health will be forgone ($D_c = r_c - g_v + g_k$) (Claxton et al., 2011).[12] This becomes even more difficult when changes in the consumption opportunity costs of health care expenditure must be accounted for and becomes impossible when these key quantities do not evolve at a constant rate. This approach poses more difficulties and potential for confusion, with dual discounting being used to account for changes in the value of health and changes in the marginal productivity of health expenditure as well as time preference. The separate and explicit accounting for each of these effects would appear more transparent, accountable and comparable.[13]

The explicit assessment of the relative value of other effects shows that the distinction between cost-effectiveness analysis which accounts for wider effects and benefit cost analysis, which incorporates the opportunity of cost or shadow prices of existing constraints, is more apparent than real. Both require the same assessment of the same key quantities in Tables 2a and 2b. Although much of the applied work to inform decision making bodies has adopted a narrower health care system perspective (in part due to a concern for the perceived cost of conflicts with other important social objectives that are more difficult to fully specify and quantify, see foot note 8) a broader 'societal' or multi sectoral perspective in CEA is possible and is required and recommended by a number of decision making bodies.[14]

The implications for discounting policy, whether conducting BCA or CEA, is that it becomes even more difficult and opaque to try and embed all these relevant arguments in how health, health care and other costs are discounted. The quantification and conversion of the time streams of multiple

[12] This approximation is based on the plausible assumption that $r_h$, $g_v$ and $g_k$ are small.

[13] The UK DH and AAWG 'best practice' report suggests that health opportunity costs are dealt with explicitly and separately from discounting. Nonetheless they recommend a discount rate of 1.5% for health and health care costs and 3.5% for other effects, which embeds the expectation that the consumption value of health will grow at 2%. This happens to nullify the wealth effect in UK Treasury STP based on the Ramsey Rule.

[14] Drummond et al 2015, Section 4.5.3 page 112-116. For example NICE requires a primary analysis from the perspective of the health care system. However, an analysis that includes other effects can be considered and are required for public health interventions and programs. Other decision making bodies in the Netherlands and Sweden require a broader perspective to be adopted as the primary analysis. A societal perspective was recommended as reference case analysis by the Washington Panel (Gold et al. 1996) , alongside a health care system perspective is recommended in the reference case by the Washington Panel. The recent update to this guidance (Neumann et al 2016) recommends analysis from both a societal and health care system perspective.

effects to a common numeraire which can then be discounted may best be done separately and explicitly, reflecting evidence of likely opportunity costs and the consumption value of health, allowing available evidence to be used transparently and consistently, while preserving the possibility of accountable deliberation about evidence, values and unquantified arguments.

### 1.2.1 Time preference for consumption

How to think about time preference for consumption effects is well established and well worked through the Ramsey Rule ($r_c=\delta + \eta g_c$). This includes pure time preference (δ, i.e., time preference for utility) and a wealth effect ($\eta g_c$) which reflects the relative weight attached to consumption opportunities in future compared to the current period. Although an individual might exhibit forms of pure time preference there are good, albeit disputed, normative reasons to set pure time preference aside when making social choices that will have effects on current and future populations (##Ramsey, Stern, Arrow##). The wealth effect in the Ramsey Rule requires some assessment of the growth in future consumption opportunities ($g_c$) and the weight that ought to be attached to them ($\eta$). This can be cast in a number of ways (e.g., based on individual diminishing marginal utility of consumption) and appeal to different forms of evidence (##Groom add ##). However when considering social choices about projects which have impacts on current and future populations it might be best thought of as a form of inequality aversion where expectations of future growth in consumption opportunities mean that additional consumption for future beneficiaries should be give less weight than the same additional consumption for current beneficiaries where their other consumption opportunities are more limited. The important thing to note, which is likely to be especially relevant to LMICs is that $r_c$ will always be country specific because even if η is common (and it need not be) it will be driven by expectations about future consumption growth which are likely to differ between countries with different levels of income and also differ between those with similar levels of current income but different expectation about future economic growth (see Section 2.3).

## 1.3 Other considerations

### 1.3.1 Catastrophic risk

Truly catastrophic risk is best thought of as the probability of an event would mean that all public and private projects will have zero cost and benefits, i.e., an event that represents total catastrophe for the whole of society. When cast in this way it excludes events which are 'catastrophic' but where some recovery might be possible even if this requires assistance from others (other countries, global bodies). This is important as although a 'catastrophic' event where recovery is possible may have a major impact on the costs and benefits of public and private projects these impacts are unlikely to be the same for all projects. Therefore, these types of 'catastrophic' but recoverable risks are best included in the evaluation of the project itself though analysis of project specific risks (and the interaction with macroeconomics risk) rather than being embedded in a common discount rate for consumption effects.

### 1.3.1 Project specific risk

Considerable efforts have been made in the evaluation of projects with health effects to characterise all sources of uncertainty, value the consequences and establish how these should inform project choice; for example, whether the approval of a cost- effective project (NPV>0) should be delayed or access restricted until further research is conducted or until sources of uncertainty resolve overtime (e.g., the entry and change in price of competing interventions). The impact of irrecoverable costs and the real option value of delay have been examined as well as the impact of approval on the opportunities to acquire evidence that would benefit future patient populations. The impact of uncertainty on resource allocation across projects under alternative budgetary policies and the implications uncertain non-marginal budget impacts have also been examined (see Drummond et al 2015, Chapter 11 for an accessible summary).

This type of analysis starts to unpick the reasons for the appearance of risk aversion in project choice and undermines the justification for embedding a risk premium in discount rates. The evaluation of health care projects is increasingly attempting to explicitly model many of the effects that are otherwise embedded in project specific and catastrophic risk premiums. Although the application of this type of analysis (value of information, Bayesian decision theory and real options) is well developed in the evaluation of health projects, [15] it is far from universal. Nonetheless, some project evaluations, may have already accounted for the consequences of some of these project specific risks in a way that others in health or other policy and project evaluations may not. In any event these risks and their consequences for costs and benefits necessarily differ by project so should certainly not be embedded in a common discount rate for the consumption effects of heath projects. They might be best included in the evaluation of the project itself, rather than amending a common discount rate for consumption with project specific risk premiums.

### 1.3.2 Macroeconomic risk or prudential savings

<<TBC>>

The time horizon for the evaluation of many projects with health effects are often less than 30 years or generally do not extend much beyond that. For example, insofar as a project impacts on mortality risk the time horizon for costs and benefits need only extend to the survival of the cohort of current beneficiaries. However, projects which change the dynamics of infectious or contagious disease and/or require commitment of irrecoverable costs also require an assessment over the survival of future incident cohorts that will be affected or will benefit from the investment. Similarly the value of information generated by clinical research also includes future patient populations. If all effects are expressed as streams of consumption gains and losses then discounting using STP would be appropriate, including any decline over longer time horizons to reflect the impact of uncertainty in the consumption growth element of the wealth effects of the Ramsey Rule. A decline

[15] For example, a characterisation of 'all' sources of uncertainty is required by NICE appraisal and value of information analysis is recommended. NICE is considering how more formal analysis of the value of additional evidence and irrecoverable costs can inform it's only in research recommendations.

in $r_c$ is required to account for the non-linear relationship between uncertainty in $r_c$ in a particular period and the expected present value of the net consumption effects in that period. Since uncertainty in $r_c$ will increase over time, due to increasing uncertainty in future consumption some decline is required to return the correct net present values which account for this non- linearity.[16]

The effect is also described as macroeconomic risk or prudential saving and is more modest over shorter terms (##refs##). However, for longer terms, or where macroeconomic risk is greater and increases more rapidly with term (as is more likely in LMICs) declining rates might be required but should be based on uncertainty in consumption growth rather than individual behavioural evidence (see section 2.4.3).

### 1.3.3 The interaction of macroeconomics and project specific risk

<<TBC>>

The interaction of project specific and macro risk is not often considered in the evaluation of social projects. Nonetheless, the possibility of counter cyclical risk makes projects more valuable than their expectation and pro cyclical ones less valuable. This is likely to be especially important in LMIC settings where both macro and project risk might be greater at any given term and where project risks might be more strongly correlated with macro risk if they represent a greater share of economic activity or have greater effects on the proportion of total economic activity than in higher income settings. (see section 2.4.4).

## 2. Evidence available to inform key quantities and possible default estimates

### 2.1 Opportunity costs and their evolution over time

### 2.1.1 Health opportunity costs of health care expenditure ($k_{ht}$)

The problem of estimating a cost-effectiveness 'threshold' that represents expected health opportunity costs is the same as estimating the relationship between changes in health care expenditure and health outcome.[17] Estimates of the marginal productivity of health expenditure in producing health (QALYs) are becoming available for some high income countries based on approaches to estimation which exploit within country data (Martin et al 2008, Claxton et al 2015a, and Vallejo-Torres et al, 2017). The proportionate effect on all-cause mortality of proportionate changes in health expenditure (outcome elasticities) have also been estimated in higher income countries (e.g., UK, Spain, Australia and South Africa) using similar approaches to estimation of within country data and have reported similar estimates. This evidence from higher income settings

[16] For example the alternative would be to take repeated samples from the distribution of future consumption, apply each realised $r_c$ to effects in that period and then take the expectation across all the simulated NPVs for effects in that period. Other key parameters are also uncertain and increasingly uncertain in future periods (e.g., $k_{ht}$ and $v_{ht}$ which are both ratios) however, so long as the estimates used are ratios of the expected effects, rather than the expectation of possible ratios, there relationship to NPV is multi linear so no similar decline is required to return the correct NPVs.

[17] See Drummond et al 2015 Section 4.3 page 83-94; Section 4.3.3.1 page 95-95

can be used to give some indication of possible values in lower income countries (Woods et al 2016) based on a number of assumptions about income elasticity of demand for health and the relative 'under funding' of health care systems. This type of extrapolation suggests that cost per DALY averted is likely to be less than 1 GDP per capita in middle income countries and substantially lower than that in low income countries.

The effect of different levels of health care expenditure on mortality outcomes has been investigated in a number of published studies using country level data, many including low and middle income countries (LMICs) (Gallet and Doucouliagos 2015). The challenge is to control for all the other reasons why mortality might differ between countries in order to isolate the causal effect of differences in health expenditure. This is a particular challenge even if available measures are complete, accurate and unbiased because health outcomes are likely to be influenced by expenditure (increases in expenditure improves outcomes), but outcomes are also likely to influence expenditure (poor outcomes prompt greater efforts and increased expenditure) (Nakamura et al, 2016). This problem of endogeneity, as well as the inevitable aggregation bias, risks underestimating the health effects of changes in expenditure.

Instrumental variables have been used in a number of studies to try and overcome this problem and estimate outcome elasticities for all cause adult and child mortality, by gender, as well as survival, disability and DALYs (Bokhari et al, 2007). These estimated elasticities have been used to provide country specific cost per DALY averted values for 123 countries, taking account of measures of a country's infrastructure, donor funding, population distribution, mortality rates, conditional life expectancies (all by age and gender), estimates of disability burden of disease and total health care expenditure (Ochalek et al 2015). These estimates have recently been updated and work funded by BMGF is underway to assess how cost per DALY averted is likely to evolve with changes in health care expenditure and consumption growth *(Ochalek et al 2017)*.

***Possible default estimates* ($k_{ht}$)**

*Despite considerable data and estimation challenges some initial quantitative assessment of health opportunity costs and how they are likely to evolve is possible based on the balance of evidence such as it is. Updated estimates for almost all LMICs for 2015 expenditure are now available which might provide useful initial default estimates. Initial projections of these estimates based on other published projections of health expenditure and consumption are also available (Ochalek et al 2017). These initial country specific estimates can be refined and updated as other country specific estimates emerge, ideally using within country data where this is possible.*

*<<TBC>>*

*Some limited evidence of different categories for health expenditure*

I. *Types of collectively pooled but only in HIC (Claxton et al 2015 and 2017)*
II. *Different type of expenditure, some in LMICs eg collectively pooled resources, privately pooled and out of pocket (Moreno Smith 2015)*

*Some limited evidence for Jurisdictions, provinces, states or regions within health care systems(e.g., Canadian provinces and Indian States)*

*Limited evidence of opportunity costs or shadow prices of other categories of public expenditure but default estimates are possible (see 2.2.1)*

### *2.1.2 Consumption opportunity costs of health care expenditure ($k_{ct}$)*

This requires either direct evidence of the impact of changes on health care expenditure on net production in the wider economy (i.e., consumption opportunities) or estimates of the impact that changes in health are likely to have on consumption opportunities in the rest of the economy (which with evidence from 2.2.1 the former can be derived from the latter).

Attempts to estimate and explicitly account for this non health opportunity cost of health expenditure are particularly limited even in high income settings but do exist.[18] There are no explicit estimates for other countries, but a wide literature already exists at a micro level (e.g., health and labour market outcomes) and at a macro level (e.g., health and economic growth) which could be marshalled to derive estimates of the likely productive effects of changes in health relevant to different setting. These types of estimates could provide some default assessment of the net production effects likely to be associated with the particular type of health benefits offered by a project which has health effect. Importantly, they can also be linked to evidence of health opportunity costs in 2.2.1 to estimate the consumption opportunity costs of health care expenditure.

**Possible default estimates *($k_{ct}$)***

*In the absence of marshalling existing but disparate evidence a default assumption of 1 (1$ spent on health care delivers 1$ in net production or consumption opportunities) might not be unreasonable, albeit conservative assumption in LMIC settings given the very limited evidence currently available (see foot note 17). Although there is little evidence about how this aspect of opportunity costs is likely to evolve, a default assumption that the real value of the net production effects of the health effects of changes in health expenditure will grow at the same rate as consumption opportunities may not be unreasonable.*

## 2.2 Consumption value of health and its evolution over time ($v_{ht}$)

There is a large literature which has used stated preferences (contingent valuation and discrete choice experiments) to estimate the consumption value or willingness to pay for improvements in health (e.g., Pinto-Prades 2009, Mason et al 2009). Recent reviews of this literature reveal wide variation in values (Vallejo-Torres et al, 2016; Ryen and Svensson, 2015;). The estimates reflect the demand for health and imply what health care expenditure ought to be, rather than a 'supply side' assessment of health opportunity costs. Most estimate how much consumption an individual is

[18] For example, as part of efforts to inform value based pricing of branded medicines (DH 2010 NICE 2014), the DH undertook work to estimate the 'wider social benefits' associated with changes in health outcome which could be linked to evidence of health opportunity costs to estimate the net production opportunity costs of changes in health expenditure. The evidence in the UK suggests that a marginal £ in the NHS budget provides 92p worth of net production gains (see Appendix B of Claxton et al 2015b).

willing to give up to improve their own health. A few try to elicit how much individuals believe society should pay to improve health more generally. A wider literature, that extends beyond health, estimates the value of a statistical life (VSL) based on how much consumption individuals are willing to give up to reduce their mortality risk (Hammitt 2000, Robinson et al 2016). Some studies are based on stated preferences (e.g., Lindhjelm 2011) but others identify situations where individuals make choices that imply a value, e.g. revealed preferences in the labour market. A cost per DALY can be derived from these studies by making assumptions about age and gender distribution, conditional life expectancies and quality of life norms.

Most of this literature report values relevant to high income countries and other methods papers for the BCA reference case deal in more detail about how a consumption value of health relevant to LMIC settings might be derived. However, some patterns that emerge are also likely to be relevant to LMICs: estimates based on VSL studies tend to be higher than those based on willingness to pay for health; values are not proportional to the scale of health gains and differ depending on whether health gains are through quality improvement or survival benefits.

Although there is limited direct empirical evidence which provides values in lower income settings there is some limited evidence about how values might evolve over time with growth in consumption. Reviews of the literature that have investigated the relationship between the VSL and income (e.g., Viscusi and Aldy 2003; and Hammitt and Robinson 2011) suggests that earlier cross sectional studies of wage-risk premiums indicate income elasticities <1, but longitudinal or cohort studies typically estimate elasticities >1. (e.g., Costa and Kahn 2004). The reasons for these differences may be that cross-sectional studies are more likely to reflect changes in realised income, whereas longitudinal or across cohort studies are more likely to capture the impact of permanent income (e.g., Getzen 2000; Aldy and Smyth 2014). Despite the empirical difficulties the balance of evidence suggests that the consumption value of health increases with income. Assuming an income elasticity of demand of health ≥1 may not be unreasonable.

There are also sound theoretical reasons why the value of health would be expected to grow with consumption (e.g., Parsonage and Neuburger 1992, Gravelle and Smith 2001, Hall and Jones 2007). The intuition can be expressed in the same way as the expected increase in value of environmental goods; that the growth in consumption is likely to outstrip the growth in health so health will become scarcer relative to consumption. Since consumption is an imperfect substitute for health the value of health will increase. These arguments can be made using behavioural models of individual choices of health affecting activities over time e.g., purchasing health care. The growth in the value of health will be determined by income growth, the income elasticity of demand for health care and the elasticity of the marginal productivity of health care. Alternatively health can be included as a separate argument in a social welfare function where it is valued in its own right, in part, because a healthier state increases the marginal utility of income and an indirect effect through income due to uninsured health care costs and/or increased productivity of being in a healthier state. These insights indicate there are compelling reasons to believe the consumption value of health will grow with income and it is likely to grow at a faster rate if there is a direct effect of health on utility and an indirect effect through income.

***Possible default estimates*** **($v_{ht}$)**

*Although theoretical arguments point to a number of empirical questions, a simple but reasonable assessment of how $v_{ht}$ is likely to evolve could be based on growth in consumption (which is already required and embedded in the wealth effect of the Ramsey Rule) and a default assumption about the income elasticity of demand for health. An income elasticity of demand for health of 1 might be a reasonable default assumption in which case $v_{ht}$ would grow in the same way as consumption. Alternative scenarios could be justified based on evidence that income elasticity is likely to differ in particular settings.*

#### *2.2.1 Other constrained sectors ($v_{xt}/k_{xt}$)*

Reported values also tend to be higher than available estimates of a 'supply side' assessment of health opportunity costs (Vallejo-Torres et al, 2016). This suggests a common discrepancy between the demand and supply side of health care systems. For example, if these estimates are regarded as an appropriate expression of social value, the difference between $v_{ht}$ and $k_{ht}$ would indicate that health care from collectively pooled resources is 'underfunded' compared to individual preferences about health and consumption.[19] It is consistent with the view that the public funding of health care is not matching individual preferences and public expectations of their health care system. However, given the difficulties faced in the public financing of health care and the welfare losses associated with socially acceptable means of taxation this is what might be expected and especially so in lower income settings where the difficulties of public financing are more acute. The balance of evidence suggests that $v_{ht}/k_{ht} > 1$. This ratio is the shadow price for public health expenditure (the value of health expenditure $ relative to private consumption $).

***Possible default estimates ($v_{xt}/k_{xt}$)***

*Estimates of $v_{ht}/k_{ht}$ in the health sector might be used to shadow price other forms of public expenditure (where the equivalent estimates for that sector are absent) since resource allocation and expenditure decisions by government and other ministries would be expected to equalise this ratio across sectors (x) given an overall constraint on total public expenditure, i.e., it may not be unreasonable to assume $v_{ht}/k_{ht} = v_{xt}/k_{xt}$ when considering impacts on public sector x.*

### 2.3 Time preference for consumption ($r_c$)

There is some empirical evidence to inform $\eta$ in high income countries (##Groom + ##) as well as reviews of expert opinion. However, the balance of this evidence for high income settings suggests that there is some elements of inequality aversion with values of $1<\eta<2$ not being unreasonable (##refs##). There are also possibilities of obtaining revealed values for $\eta$ through other social choices (e.g., the progressivity of tax and benefit systems) or alternatively focusing on growth in median income (##refs##) rather than applying an estimated $\eta$ to expected growth in mean income.

[19] For example, the UK DH has adopted £15,000 per QALY to assess health opportunity costs and until recently £60,000 per QALY as an estimate of the consumption value of health based on deriving QALY effects from VSL estimates. This would suggest that one health care £ is worth £4 of private consumption effects, which is especially important when there are other impacts which fall outside constrained public expenditure.

Little direct evidence of $\eta$ exists for LMICs; nonetheless country specific default estimates of $r_c$ are possible.

***Possible default estimates***

*One way to establish default country specific estimates of $r_c$ would be to apply $\eta$ =1 as a default assumption to the expected growth in consumption opportunities (reported as expected growth in measures of national income per capita for that country). Alternative scenarios could be justified based on evidence or reasoning of why $\eta$ is likely to differ in specific contexts or based on different judgements about the prospects of future economic growth by social planners. As evidence for values of $\eta$ specific to LMICs evolves and estimates of economics growth are revised these defaults can be updated. This can also be compared to a wealth effect based only on expected growth in median income if and when those are reported.*

## 2.4 Catastrophic, project specific and macroeconomic risk

### 2.4.1 Catastrophic risk

There are sources for elicited probabilities of truly catastrophic events where recovery would not be possible (#ref#). The probabilities are relatively small and if included would add little to a common discount rate for consumption effects. Given the other more influential sources of uncertainty in specifying reasonable default values for a common discount rate for consumption effects it might be reasonable to explicitly set aside truly catastrophic risks.

***Possible default estimates***

*Exclude catastrophic risk from a common discount rate for consumption effects or base an estimate on elicited probabilities of truly catastrophic events where recovery would not be possible (<0.1%)*

### 2.4.2 Project specific risk

***Possible default estimates***

Project specific risks should be included in the analysis and how 'consumption equivalent' time streams of effects are estimated rather than embedded in a project specific discount rate.

### 2.4.3 Macroeconomic risk and prudential saving

The effect of macroeconomic risk and prudential saving (due to increasing uncertainty in future consumption) is more modest over shorter terms (##refs##). However, for longer terms, or where macroeconomic risk is greater and increases more rapidly with term (as is more likely in LMICs), any declining rates should be based on uncertainty in consumption growth rather than individual behavioural evidence.

***Possible default estimates***

The use of $r_c$ without adjustment for macroeconomics risk maybe a reasonable default assumption for projects with time horizons less than 30 or 40 years. Where there are longer time horizons or where macroeconomic risk is greater and increases more rapidly with term any declining rates should be based on the nonlinear effect of uncertainty in $r_c$ on expected NPV in future periods due to uncertainty in consumption in that period. Since growth and uncertainty about that growth will be country specific any decline in $r_c$ will necessarily be country specific. Any declining rates for $r_c$ should be based on an initial assumption of beta=1 for all projects (see 2.4.4).

### 2.4.4 Interaction of project specific and macroeconomic risk

The interaction of project specific and macro risk is not often considered in the evaluation of social projects. Nonetheless, the possibility of counter cyclical risk makes projects more valuable than their expectation and pro cyclical ones less valuable. This is likely to be especially important in LMIC settings where both macro and project risk might be greater at any given term and where project risks might be more strongly correlated with macro risk if they represent a greater share of economic activity or have greater effects on the proportion of total economic activity than in higher income settings.

***Possible default estimates***

*In the absence of estimates of Betas for projects and lack of experience in the field of doing so, a qualitative indication of whether or not projects are likely to be strongly pro or counter cyclical would be a useful starting point for deliberation by decision makers, while further research is conducted on how the effects of these interactions might be best quantified for these types of project relevant to LMICs.*

## 3 Recommendations, default estimates and reporting

### 3.1 Key quantities and summary possible default estimates

All these of key quantities (other than the directly estimated effects of the project) depend, directly or indirectly on expectations about the growth in consumption opportunities. This has two implications. Firstly, all these quantities will be country specific including $r_c$, which this has implications for aggregating effects of a project that is relevant to a number of different jurisdictions (see 3.2.1). Secondly, it is important than any assessment of expected growth in consumption is consistently applied to inform all the key quantities that depend on it, so that any change in these expectations or any alternative judgments about $g_c$ feeds through into all the relevant parameters.

It should be noted that on balance the suggested default estimates summarised in Table 3 are more likely to under than over estimate a common discount rate for consumption effects and may also underestimate the rate of growth in in the consumption value of health. This is worth noting when constructing alternative scenarios to reflect the impact of uncertainty in these key quantities.

**Table 3 Key quantities and possible default estimates and assumptions**

| Key quantity | | Possible default estimates |
|---|---|---|
| Health opportunity costs of health care expenditure | $k_{ht}$ | *Updated estimates for almost all LMICs for 2015 expenditure are now available which might provide useful initial default estimates. Initial projections of these estimates based on other published projections of health expenditure and consumption are also available (Ochalek et al 2017). These initial country specific estimates can be refined and updated as other country specific estimates emerge, ideally using within country data where this is possible.* |
| Consumption opportunity costs of health care expenditure | $k_{ct}$ | *A default assumption of 1 (1$ spent on health care delivers 1$ in net production or consumption opportunities) might not be an unreasonable, albeit conservative assumption in LMIC settings. A default assumption that the real value of the net production effects of the health effects of changes in health expenditure will grow at the same rate as consumption opportunities may not be unreasonable.* |
| Consumption value of health and its evolution over time | $v_{ht}$ | *An assumption of how $v_{ht}$ is likely to evolve could be based on growth in consumption (which is already required for $r_c$) and a default assumption about the income elasticity of demand for health. An income elasticity of demand for health of 1 might be a reasonable default in which case $v_{ht}$ would grow in the same way as consumption. Alternative scenarios could be justified based on evidence that income elasticity is likely to differ.* |
| Other constrained sectors | $v_{xt}/k_{xt}$ | *Estimates of $v_{ht}/k_{ht}$ in the health sector might be used to shadow price other forms of public expenditure (where the equivalent estimates for that sector (x) are absent) because it may not be unreasonable to assume that $v_{ht}/k_{ht} = v_{xt}/k_{xt}$ when considering impacts on public sector x.* |
| Time preference for consumption | $r_c$ | *Apply $\eta$ =1 as a default assumption to the expected growth in consumption opportunities (reported as expected growth in measures of national income per capita for that country). Alternative scenarios could be justified based on evidence or reasoning of why $\eta$ is likely to differ in specific contexts or based on different judgements about the prospects of future economic growth by social planners. As evidence for values of $\eta$ specific to LMICs evolves and estimates of economics growth are revised these defaults can be updated.* |
| Catastrophic risk | | *Exclude catastrophic risk from a common discount rate for consumption effects or base an estimate on elicited probabilities of truly catastrophic events where recovery would not be possible (<0.1%)* |
| Project specific risks | | Project specific risks should be included in the analysis and how 'consumption equivalent' time streams of effects are estimated rather than embedded in a project specific discount rate. |
| Macroeconomic risk and prudential saving | | The use of $r_c$ without adjustment for macroeconomics risk maybe a reasonable default assumption for projects with time horizons less than 30 or 40 years. Where there are longer time horizons or where macroeconomic risk is greater and increases more rapidly with term any declining rates should be based on the nonlinear effect of uncertainty in $r_c$ on expected NPV in future periods due to uncertainty in consumption in that period. Since growth and uncertainty about that growth will be country specific any decline in $r_c$ will necessarily be country specific. Any declining rates for $r_c$ should be based on an initial assumption of beta=1 for all projects |
| Interaction of project specific and macroeconomic risk | | *In the absence of estimates of Betas for projects and lack of experience in the field of doing so, a qualitative indication of whether or not projects are likely to be strongly pro or counter cyclical would be a useful starting point for deliberation by decision makers, while further research is conducted on how the effects of these interactions might be best quantified for these types of project relevant to LMICs.* |

## 3.2 Reporting

<<TBC>>

Extensive reporting is recommended as illustrated in Tables 1, 2a and 2b

### 3.2.1 Aggregating effects across jurisdictions

Some projects and supra national investments will have effects across different counties where all the key quantifies discussed above will differ. Other projects and national investments will have effects across jurisdiction where only some of these key quantities may differ (e.g., $k_{ht}$). The discount rate for equivalent consumption effects ($r_c$) will always be country specific because even if $\eta$ is common (and it need not be) it will be driven by expectations about future consumption growth which are likely to differ between countries with different levels of income and also differ between those with similar levels of current income but different expectations about future economic growth. Indeed, all the key quantities depend directly or indirectly on future growth in consumption

opportunities so they must also be country specific. The means that the cross country (or cross jurisdiction) effects of projects cannot be summed across countries, transformed into equivalent consumption and then discounted. Instead country specific effects must be transformed into country specific time streams of equivalent consumption and then discounted at the country specific rate fir consumption effects. The country specific NPVs can then be summed to indicate the global NPV of a project with effects in a number of countries. The is illustrated in Table 4 for a project with effects on health, health care costs and consumption in two counties A and B.

**Table 4. Reporting the effects of a project with impacts on more than one jurisdiction**

| | Equivalent consumption effects across countries or jurisdictions | | |
|---|---|---|---|
| | **Country *A*** | **Country *B*** | **Country *C*** |
| **Effects in period t** | $v^A_{h,t}\left[\Delta h^i_t - \frac{\Delta c^A_{h,t}}{k^A_{h,t}}\right] - \left[\Delta c^A_{c,t} + k^A_{c,t}.\Delta c^A_{h,t}\right]$ | $v^B_{h,t}\left[\Delta h^B_t - \frac{\Delta c^B_{h,t}}{k^B_{h,t}}\right] - \left[\Delta c^B_{c,t} + k^B_{c,t}.\Delta c^B_{h,t}\right]$ | $v^C_{h,t}\left[\Delta h^C_t - \frac{\Delta c^C_{h,t}}{k^C_{h,t}}\right] - \left[\Delta c^C_{c,t} + k^C_{c,t}.\Delta c^C_{h,t}\right]$ |
| **Net present value** | $\sum_{t=1}^{T} \frac{v^A_{h,t}\left[\Delta h^A_t - \frac{\Delta c^A_{h,t}}{k^A_{h,t}}\right] - \left[\Delta c^A_{c,t} + k^A_{c,t}.\Delta c^A_{h,t}\right]}{\left(1+r^A_c\right)^t}$ | $\sum_{t=1}^{T} \frac{v^B_{h,t}\left[\Delta h^B_t - \frac{\Delta c^B_{h,t}}{k^B_{h,t}}\right] - \left[\Delta c^B_{c,t} + k^B_{c,t}.\Delta c^B_{h,t}\right]}{\left(1+r^B_c\right)^t}$ | $\sum_{t=1}^{T} \frac{v^C_{h,t}\left[\Delta h^C_t - \frac{\Delta c^C_{h,t}}{k^C_{h,t}}\right] - \left[\Delta c^C_{c,t} + k^C_{c,t}.\Delta c^C_{h,t}\right]}{\left(1+r^C_c\right)^t}$ |
| **Global net present value** | $\sum_{t=1}^{T} \frac{v^A_{h,t}\left[\Delta h^A_t - \frac{\Delta c^A_{h,t}}{k^A_{h,t}}\right] - \left[\Delta c^A_{c,t} + k^A_{c,t}.\Delta c^A_{h,t}\right]}{\left(1+r^A_c\right)^t} + \sum_{t=1}^{T} \frac{v^B_{h,t}\left[\Delta h^B_t - \frac{\Delta c^B_{h,t}}{k^B_{h,t}}\right] - \left[\Delta c^B_{c,t} + k^B_{c,t}.\Delta c^B_{h,t}\right]}{\left(1+r^B_c\right)^t} + \sum_{t=1}^{T} \frac{v^C_{h,t}\left[\Delta h^C_t - \frac{\Delta c^C_{h,t}}{k^C_{h,t}}\right] - \left[\Delta c^C_{c,t} + k^C_{c,t}.\Delta c^C_{h,t}\right]}{\left(1+r^C_c\right)^t}$ | | |

## 4 Priorities for future research

<<TBC>>

## 5 Concluding remarks

The two alternative normative positions described above have implications for the valuation of effects and for discounting. What distinguishes them is a choice of whether social values ought to reflect those implied by the outcome of legitimate processes (e.g., government setting budgets for health care) or a notion of welfare founded on individual preferences expressed through markets and/or their surrogates. For example, the former suggests a social time preference for health of $r_s$ -$g_k$ and the latter, $r_c - g_v$. The distinction is whether social value is expressed by $k_t$ or $v_t$ and whether it is the opportunity cost of financing health care or the welfare arguments that underpin the Ramsey Rule that justify discounting.[20]

[20] The actual differences may be modest if $g_k$ and $g_v$ are similar and the real rate at which government can borrow is regarded as a reasonable proxy for STPR as some argue it is (Council of Economic Advisers 2017).

The purpose of this paper is not to prescribe a particular view or decide whether discounting policies should reflect the normative position that has been adopted in most evaluations of health care projects for decision making bodies, or a broader view of welfare that would be consistent with the welfare arguments that underpin the Ramsey Rule. Rather, the purpose is to clearly set out the implications, for the quantities that need to be assessed, irrespective of the normative position taken.

When it is believed to be important to explicitly quantify other impacts beyond measures of health and public health expenditure it may be appropriate to convert all effects into streams of the equivalent consumption gains and losses, while reflecting the opportunity costs of existing constraints. These time streams of equivalent consumption gains and losses can then be discounted at STP for consumption based on the Ramsey Rule.

This approach avoids embedding multiple augments in the discount rate for health and health care costs. The separate and explicit accounting for these arguments allows clarity about the quantities that need to be assessed, available evidence to be identified and used transparently and consistently, while preserving the possibility of accountable deliberation about evidence, values and unquantified arguments in decision making processes.

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