Health Policy and Planning, 35, 2020, 107–114
doi: 10.1093/heapol/czz127
Advance Access Publication Date: 18 October 2019
Methodological musings

On discount rates for economic evaluations in global health

Markus Haacker [1,2,3,*], Timothy B Hallett[4] and Rifat Atun[1,5]

[1]Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Harvard University, 677 Huntington Avenue, Boston, MA 02115, USA, [2]Centre for Global Health Economics, Faculty of Population Health Sciences, University College, 30 Guilford Street, London WC1N 1EH, UK, [3]Center for Global Development, 2055 L St NW, Washington, DC 20036, USA, [4]MRC Centre for Global Infectious Disease Analysis, School of Public Health, Imperial College London, St Mary's Hospital, Norfolk Place, London W2 1PG, UK and [5]Department of Global Health and Social Medicine, Harvard Medical School, Harvard University, 641 Huntington Avenue, Boston, MA 02115, USA

*Corresponding author. Department of Global Health and Population, Harvard T.H. Chan School of Public Health, 677 Huntington Avenue, Boston, MA 02115, USA. E-mail: mhaacker@hsph.harvard.edu

Accepted on 11 September 2019

Abstract

Choices on discount rates have important implications for the outcomes of economic evaluations of health interventions and policies. In global health, such evaluations typically apply a discount rate of 3% for health outcomes and costs, mirroring guidance developed for high-income countries, notably the USA. The article investigates the suitability of these guidelines for global health [i.e. with a focus on low- and middle-income countries (LMICs)] and seeks to identify best practice. Our analysis builds on an overview of the academic literature on discounting in health evaluations, existing academic or government-related guidelines on discounting, a review on discount rates applied in economic evaluations in global health, and cross-country macroeconomic data. The social discount rate generally applied in global health of 3% annually is inconsistent with rates of economic growth experienced outside the most advanced economies. For low- and lower-middle-income countries, a discount rate of at least 5% is more appropriate, and one around 4% for upper-middle-income countries. Alternative approaches—e.g. motivated by the returns to alternative investments or by the cost of financing—could usefully be applied, dependent on policy context. The current practise could lead to systematic bias towards over-valuing the future costs and health benefits of interventions. For health economic evaluations in global health, guidelines on discounting need to be adapted to take account of the different economic contexts of LMICs.

Keywords: Discount rates, global health, cost-effectiveness analysis, benefit-cost analysis, economic growth, low-income countries, middle-income countries

Introduction

The article addresses good practice on discounting in global health, i.e. in health economic evaluations with a focus on low- and middle-income countries (LMICs). It takes as its point of departure discussions on the practice and literature on the use of discounting in evaluative and modelling studies among an epidemiologist, a health systems scientist and a macroeconomist, all with experience in economic analyses on health policy challenges across LMICS, and in engaging with academics and policymakers in these countries. Two related observations emerged from these discussions. First, motivating the choice of a discount rate of 3%—which is established as a standard in global health, notably through the recommendations of the Panels on Cost-Effectiveness in Health and Medicine (Gold *et al.*, 1996; Neumann *et al.*, 2016)—in discussions with decision-making counterparts can be challenging, especially when they are attuned to a wider fiscal perspective. Second, there is a wide gap between the literature in macroeconomics and public finance, in which appropriate discount rates depend on the economic context and generally differ between countries, and the standardized practice in global health. This tension has already been acknowledged by members of the 1st Panel on Cost-Effectiveness, observing that 'the choice of

Key Messages

- Most economic evaluations in global health apply a discount rate of 3%, in line with guidelines developed for the USA.
- This discount rate is out of line with the economic context of low- and middle-income countries (LMICs), where a discount rate of 5–6% would generally be more appropriate.
- The established practice, therefore, results in systematic bias towards over-valuing the future costs and health impacts of interventions.
- In light of large variations in economic growth across LMICs, more consideration should be given to adopting country-specific discount rates.

a standard time discount rate, while guided by theory and data, is fixed by the need for a standard practice' (Weinstein *et al.*, 1996). It is arguably particularly important with regards to the LMICs, where the economic context differs from that in the USA, which is the reference point for the Panel recommendations.

Concerns on this tension in the literature, and between theory and practice, are underscored by the fact that the choice of a discount rate is a crucial determinant of outcomes of health economic evaluations (Figure 1). For example, a 1 percentage point increase in the discount rate reduces the value of an event (a one-off cost incurred, or a life-year saved) 10, 30 or 50 years away by approximately 10%, 26% and 40%, respectively, whereas the value of a flow (e.g. a recurrent treatment cost or a life extended) is reduced by 5%, 12% and 17%. (The latter depends on the discount rate at which this is evaluated, assumed at 3% in this example.)

Against this background, our objectives in this article are 2-fold. First, we assess the prevailing practice in economic evaluations in global health—reviewing influential guidelines on discounting in public or global health, as well as general (non-health-specific) national guidelines; analysing the practice on discounting in economic evaluations in global health; and deriving estimates of discount rates across countries driven by economic factors.

On this platform, we develop recommendations and options for the practice on discounting in global health, addressing the setting of discount rates in line with the economic context for specific countries or across countries, discussing the issues of differential accounting of health outcomes and costs, and of declining discount rates, reviewing alternative approaches to setting discount rates, and commenting on consistent modelling of costs and discount rates.

We see our contribution as complementary to the Panel recommendations and related guidance and recognize the value of reporting results on cost-effectiveness- or similar indicators which are standardized with respect to the discount rate. Indeed, the Panel recommendations encourage sensitivity analysis on discount rates, and the 'Gates' reference case on health economic evaluations, which is more attuned to global health challenges, encourages 'additional analysis exploring differing discount rates appropriate to the decision problem' (Wilkinson *et al.*, 2014).

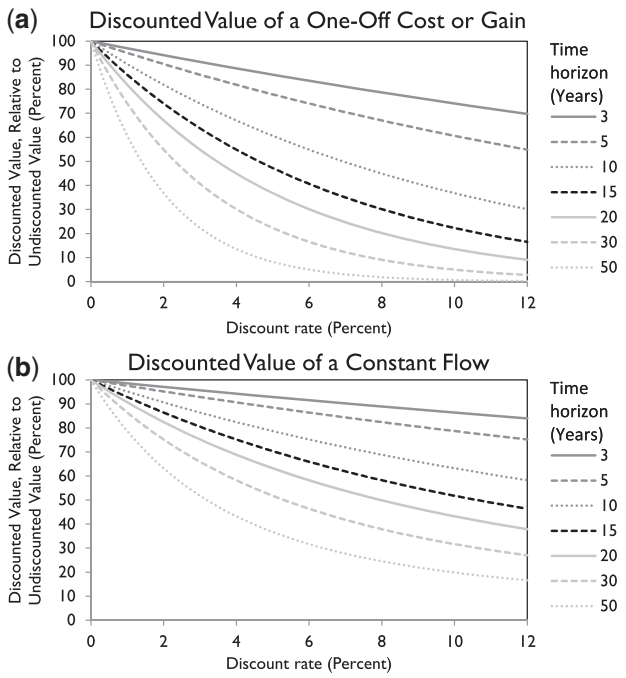

Figure 1 Value, discount rate and time horizon.

Methods

Our analysis is designed to examine standard practice on discounting, as 'guided by theory and data' (Weinstein *et al.*, 1996), in the sphere of global health. With regards to the standard practice, we draw on two sources. First, we review available guidance on health economic evaluations, including the recommendations of the Panels on Cost-Effectiveness (Gold *et al.*, 1996; Neumann *et al.*, 2016), recent reference cases of economic evaluations in global health (Wilkinson *et al.*, 2014; Robinson *et al.*, 2019) and relevant national guidelines.

Second, we review the actual practice on discounting in global health, drawing on the Global Health Cost-Effectiveness Registry database (Center for Evaluation of Value and Risk in Health, 2019), which compiles data on cost-effectiveness studies on diseases occurring predominantly in LMICs, with health outcomes measured in DALYs, published between 1995 and 2018 (median year of publication: 2012). Out of 649 studies included in the database, we considered 188 studies with a time horizon of at least 3 years, and for which information on discounting was available.

We contrast this standard practice, as evident from available guidelines and the actual practice in global health, with the general economic literature on discounting, and country-specific estimates of discount rates. Although there are several approaches to discounting in the economic literature (Table 1, also see discussion), the approach that is dominant in health economic evaluations builds on the microeconomic theory of consumption. Drawing on this approach, we obtain estimates of the discount rate across countries [using Equation (2), below], focusing on evidence with a cross-country dimension for parameters, and using estimates and projections on growth of gross domestic product (GDP) per capita from the IMF's World Economic Outlook database [International Monetary Fund (IMF), 2018].

To provide context for this calibration, and inform some of the issues around discounting we will discuss, a brief review of the relevant theory is useful. Discounting serves to interpret and aggregate benefits or costs of an intervention which occur over time. For the consumption-based approach, consider a social welfare function:

Table 1 Overview on economic approaches to discounting

Approach	Description	Selected references
Consumption rate of interest	Broadly based on the microeconomic theory of consumption, this approach combines two observations: (1) If consumption grows over time, the marginal utility of consumption declines and (2) future consumption is less valued than the same consumption today, even if the utility gains valued at the at the time are the same.	Arrow (2000), Neumann and others (2016).
Marginal productivity of capital, or 'social opportunity costs of capital'	'No project should be accepted that has a rate of return less than alternative available projects' (Burgess and Zerbe, 2011). Applies the rate of return on investment in discounting (possibly weighed according to sources of funds, e.g. domestic vs foreign financing).	Arrow (2000), Baumol (1968), Burgess and Zerbe (2011, 2013).
Social rate of discount	Applies weighted average of rate of return on capital and the consumption rate of interest, depending on which type of spending is crowded out.	Harberger and Jenkins (2015), OIRA (2011).
Shadow price of capital	Adopt the consumption rate of interest, but apply a multiplier (the 'shadow price') to induced changes in investment, to account for higher returns to capital than the consumption rate of interest.	Lipscomb *et al.* (1996), Moore *et al.* (2013).
Differential discounting of costs and health outcomes	Builds on same framework as consumption rate of interest. Although growing consumption means that the marginal utility of consumption decreases, health becomes more valuable in the sense of enabling the enjoyment of higher consumption. If health gains are valued according to the utility gains they confer, they need to be discounted at a lower rate than consumption.	Brouwer *et al.* (2005), Claxton *et al.* (2011), Gravelle and Smith (2001), Parsonage and Neuburger (1992), van Hout (1998).
Declining discount rates	Usually builds on consumption rate of interest, but applies lower discount rate for periods further out, to account for uncertainty in future discount rates. This approach is most common in the area of climate change, where time horizons of economic evaluations may extend over centuries.	Arrow *et al.* (2014), Cropper *et al.* (2014).

$$V = \sum_{t,i} (1+\rho)^{-t} L_{ti} u(c_t^*), \tag{1}$$

where t and i index periods and individuals, respectively, ρ is a 'pure rate of time preference' (measuring how society values gains income gains further out in a static environment), and L_{ti} is an index of an individual's state of health at time t which takes the value of 1 if the individual is alive, and 0 otherwise. Consumption enters as period average c_t^*, in line with common practice in health economic evaluations which does not consider the distribution of consumption across the population, and is assumed to grow at rate g. In this framework, future costs or consumption gains are discounted at a social discount rate of

$$r_c = \rho + \mu g, \tag{2}$$

where μ—the elasticity of the marginal utility of consumption—is a measure of how fast marginal utility declines as income increases. That is, Equation (2) states that an increment to consumption further out in the future is valued less because it is further out (ρ) and because future increments to consumption (relative to a level of consumption that is higher as a result of economic growth) convey lower marginal utility.

Much of the academic discourse on discounting in health economics regards the discounting of health benefits (see Table 1 on 'differential discounting'). In the framework, described by Equation (1), the value of health grows over time because consumption increases and being alive thus conveys higher utility. As a consequence, health increments over time, in terms of their contribution to social welfare and denominated in terms of current ($t=0$) income, need to be discounted at a lower rate r_h than future costs or consumption gains r_c, with

$$r_h = r_c - g_{vh}, \tag{3}$$

where g_{vh} represents the growth of the value of health (Gravelle and Smith, 2001). In the special yet common case of a utility function with constant elasticity ($u = c^{-\gamma}$) this takes the form

$$r_h = r_c - g_{vh} = r_c - \mu g = \rho. \tag{4}$$

We will return to the issue of 'equal discounting' (applying the same discount rate to health outcomes and costs) and 'differential discounting' (applying different discount rates to health outcomes and costs) in the Discussion section.

Findings

The influential Second Panel on Cost-Effectiveness in Health and Medicine (Neumann *et al.*, 2016; Sanders *et al.*, 2016), with a focus on the USA, recommends a discount rate of 3% for both costs and health outcomes, unchanged from the recommendations of the First Panel (Gold *et al.*, 1996), 'given available data on real economic growth and corresponding estimates of the real consumption rate of interest and to promote comparability across studies'. The 'Gates' reference case (Wilkinson *et al.*, 2014, 2016), with a mandate to support health economic evaluations funded by the Bill and Melinda Gates Foundation and thus more attuned to challenges in global health, also endorses a discount rate of 3% for both costs and health outcomes. Both guidelines encourage use of alternate discount rates for sensitivity analysis (2nd Panel) or 'appropriate to the decision problem' ('Gates'). The recent Reference Case Guidelines for Benefit-Cost Analysis provides similar guidance, but with a change in emphasis, recommending the use of 'discount rate that reflects local conditions' while estimates using a discount rate of 3% should also be reported in a sensitivity analysis (Robinson *et al.*, 2019).

Most national guidelines for economic evaluations of health interventions recommend using the same discount rate for costs and health benefits. For example, 17 out of 22 national guidelines (mostly from European countries) surveyed by Attema *et al.* (2018) follow this approach, with discount rates ranging from 1.5% to 5%. The level of the discount rate adopted is most frequently motivated by general (i.e. non-health-specific) government guidance or the

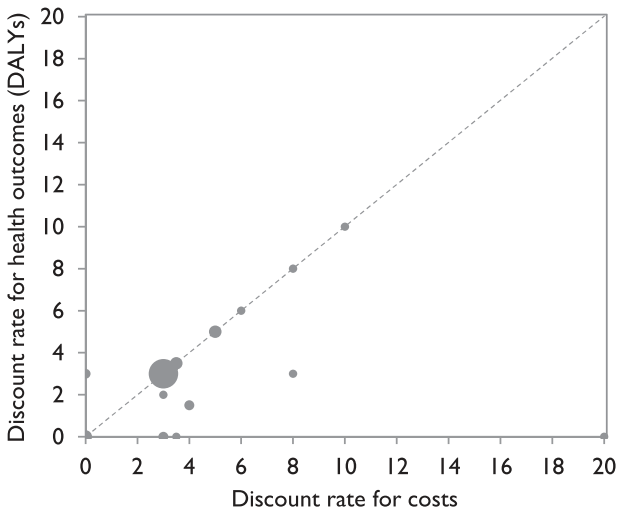

Figure 2 Discount Rates for Costs and DALYs across 188 Global Health Cost-Effectiveness Studies with time horizon of at least 3 years. *Source:* Center for Evaluation of Value and Risk in Health (2019). *Note:* Area size of bubbles is proportional to the root of the number of observations.

government's cost of borrowing. Use of a lower discount rate for health is motivated by an aversion to 'too strong penalization of interventions that generate most of their benefits in the future' (Belgian guidelines, see Cleemput *et al.*, 2012), or because the value of health increases.

Non-health specific guidelines are also relevant as they may apply to health evaluations. In the USA, 'agencies should provide benefit and cost estimates using both 3% and 7% annual discount rates' [Office of Information and Regulatory Affairs (OIRA), 2011], applying estimates of the 'social rate of time preference' and of the rate of return to private capital as benchmarks. In the UK, the Green Book, providing 'central government guidance on appraisal and evaluation', prescribes a 'social rate of time preference' of 3.5%, except for 'risk to health and life' where a discount rate of 1.5% is recommended (Her Majesty's Treasury, 2018). The Green Book, however, cautions that these discount rates could be inappropriate for development assistance projects, because economic growth rates in aid-receiving countries typically differ from those observed in the UK.

The European Commission (2018) recommends a discount rate of 5% for 'Cohesion Member States' (the less advanced EU economies, typically experiencing higher rates of economic growth), and of 3% for other member countries, 'on the basis of Social Rate of Time Preference'. A negative (but statistically insignificant) correlation between the discount rate and the level of GDP per capita also occurs in the data compiled by Attema *et al.* (2018).

Practice in global health

The practice on discounting in economic evaluations in global health overwhelmingly is aligned with the recommendation of applying a discount rate of 3% to both costs and health outcomes (Figure 2). Out of a sample of 188 relevant studies in the Global Health Cost-Effectiveness Registry database, this approach was taken by 159 studies or 85% of total. Nineteen studies (10%) adopted the same discount rate, but different from 3%, for costs and DALYs; eight studies (4%) used a lower discount rate for health outcomes than for costs; and two studies (1%) applied a discount rate of 3% for health outcomes and zero percent for costs, because the costs occurred over a very short period.

Estimates of country-specific discount rates

As expressed in Equation (2), the social rate of time preference depends on a pure rate of time preference, the rate of economic growth g, weighted by a factor reflecting the declining marginal utility of consumption. The most tangible of these components is the rate of economic growth, g. Figure 3 illustrates differences in growth of real GDP per capita across countries (left scale), plotted against the level of GDP per capita in 2017. We show both the growth experience in recent years (2007–17), which may be subject to idiosyncratic shocks (such as the 2008 global financial crisis) and the outer end of the IMF's growth projections (2022–23) as an indicator of medium-term growth projects (whereas the short-term projections reflect recent shocks).

Figure 3 shows large variations in rates of economic growth across countries, especially for LMICs, where economic growth not only tends to be higher but also subjects to higher cross-country variation, compared with advanced economies. On average, growth of GDP per capita across LMICs (approximately, with levels of GDP per capita up to US$1200, or between US$1200 and US$4000) has been and is projected to be about 2 percentage points higher than in the USA. From this perspective, the practice in global health of adopting a common rate of discount (broadly consistent with the economic situation in the USA) is out of line with the divergent growth experience in many countries and may result in bias in the domain of global health.

To arrive at estimates of social discount rates consistent with these growth rates, it is necessary to obtain estimates of the elasticity of marginal utility and of the pure rate of time preference. On the former, the survey by Groom and Maddison (2019) suggests estimates between 0.5 and 2.0. The most substantial cross-country analysis available (Evans, 2005; with a focus on advanced economies) arrives at an estimate of 1.4, which we adopt. This estimate is consistent with a review of some 200 experts who have published on social discount rates, which returns a mean value of 1.35 (Drupp *et al.*, 2018). This estimate—drawing on experts who have published on discount rates in highly ranked journals is not necessarily confined to advanced economies, though the authors acknowledge that expertise from developing countries might be underrepresented. Regarding pure time preference, we adopt a value of 1%, in line with the survey by Drupp *et al.* (2018), which returns a mean of 1.1, and broadly consistent with academic practice (Arrow *et al.* 2014; Freeman *et al.* 2018; Claxton *et al.*, 2019).

Our estimates of social discount rates for global health are summarized in Table 2, and country-specific rates are shown in Figure 3 (right scale). Because economic evaluations are forward-looking, we not only focus on projected economic growth but also show results for historical growth rates. Overall, we estimate that a discount rate of 4–6% would be appropriate as a global benchmark (applying unweighted or population-weighted averages across countries, respectively). The recommendation of the 2nd Panel of using a discount rate of 3% is a good benchmark for high-income countries only and is only ½ to 1 percentage point lower than our average estimates for upper-middle-income countries (other than China). In contrast, we obtain discount rates of 5% or higher for low- and lower-middle-income countries. Our estimates for India and China (suggesting discount rates of 9% or 10%) underscore our observations on high variability of rates of growth and hence discount rates across countries, and the value of taking into consideration country-specific circumstances. The discount rate for the USA comes out at only 2%, lower than the recommendation of the 2nd Panel but in line with Council of Economic Advisors (2017).

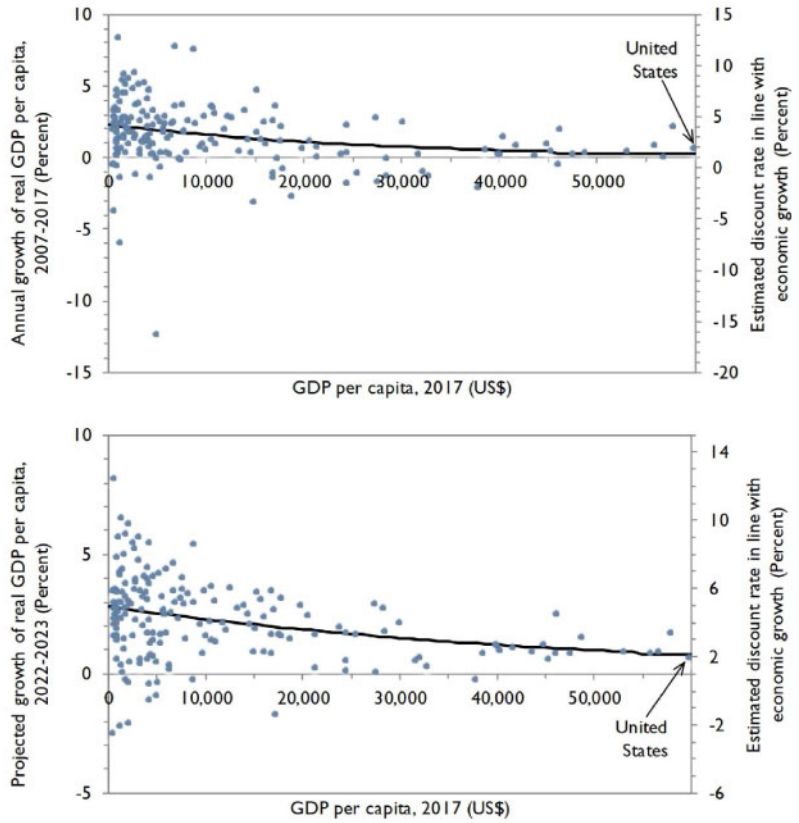

Figure 3 Annual Growth of GDP per Capita across Countries with Different Levels of Economic Development. *Data source:* IMF (2018). *Notes:* Dots represent countries, the lines describe log-linear trends. For presentational purposes, figure is truncated at a level of GDP per capita of US$60 000 (excluding Qatar, Ireland, Iceland, Norway, Macao SAR, Switzerland and Luxembourg). We also exclude Guyana, San Marino, Somalia, South Sudan, Syria and Timor-Leste because of incomplete data or the presence of large positive or negative idiosyncratic shocks.

Table 2 Economic growth and social discount rates across countries

	Growth of GDP per capita, 2007–17	Implied social discount rate	Projected growth of GDP per capita	Implied social discount rate
Unweighted averages				
All	1.7	3.3	2.2	4.1
Low-income countries	1.7	3.4	2.8	5.0
Lower-middle-income countries	2.7	4.8	2.8	4.9
Upper-middle-income countries	1.8	3.5	2.3	4.2
High-income countries	0.7	2.0	1.5	3.2
o/w GDP per capita <US$ 25 000	1.0	2.4	1.9	3.7
o/w GDP per capita ≥US$ 25 000	0.5	1.6	1.3	2.8
USA	0.7	2.0	0.7	2.0
Population-weighted averages				
All	3.7	6.2	3.7	6.1
Low-income countries	2.9	5.1	3.5	5.8
Lower-middle-income countries	4.2	6.9	4.6	7.4
India	5.6	8.8	6.3	9.9
Other	3.0	5.3	3.2	5.4
Upper-middle-income countries	4.9	7.8	3.8	6.3
China	7.7	11.8	5.5	8.7
Other	1.5	3.1	1.8	3.5
High-income countries	0.7	2.0	1.2	2.7
o/w GDP per capita <US$ 25 000	1.5	3.1	1.8	3.5
o/w GDP per capita ≥US$ 25 000	0.6	1.8	1.0	2.4

Source: IMF (2018) for macroeconomic data, World Bank (2018) for country classifications, and authors' calculations. The implied social discount rate (sdr) has been calculated as $sdr = 1.0 + 1.4 \times g$, where 'g' is the country-specific rate of growth of real GDP per capita. The projected growth rate is for the outer years (2022–23) of the projections reported in the IMF's *World Economic Outlook* database.

Discussion

A discount rate is an essential component of economic evaluations of health policy. We find, however, that the use of a discount rate of 3% as a default in global health is out of line with the economic reality of LMICs, where a discount rate of at least 5% (or 4% for upper-middle-income countries) is generally more appropriate, in light of higher rates of economic growth.

Following standard practise may, therefore, result in over-valuing future costs and health benefits. This could distort health priority setting and lead to an inefficient allocation of scarce resources for health. The magnitude of the bias in health economic evaluations from using discount rates which may be considered too low depends on the pattern of costs and health outcomes over time. For example, the value of an event 30 years outcomes out 82% higher, and the value of a constant flow over 30 years 27% higher, if a discount rate of 3% rather than 5% is used.

That is, the sensible practice of standardizing cost-effectiveness analyses with respect to discount rates in countries like the USA, when extrapolated across LMICs, comes at a cost as it results in systematic bias and—by failing to take into account local circumstances—lack of policy relevance. The specific implications depend on the perspective of the analysis. If the same social discount rate is applied to evaluate costs and outcomes (which is the dominant approach in health economics), then applying a discount rate of 3% (rather than a higher one appropriate one in line with economic growth) results in an over-valuation of costs and outcomes further out. If a welfare perspective is adopted and health outcomes are weighted higher as consumption increases (discussed in more detail below), the effect of growth on the discount rate applied to health is neutralized [recall Equation (4)]. In this case, applying the discount rate of 3% results in an over-valuation of future costs but not of health, and a systematic upward bias in cost-effectiveness ratios.

In addition to this systematic bias, it is also important to bear in mind that the economic circumstances across LMICs are highly diverse, so that the case for adopting a 'discount rate that reflects local conditions' (Robinson *et al.*, 2019) is generally stronger in the sphere of global health than across high-income countries.

One important limitation of our methods is that parameterization relies heavily on evidence from high-income countries. That is, we adjust for different rates of economic growth but cannot account for possible differences in the link between growth and discount rates across countries. Our approach is within the bounds of the literature on valuing mortality changes across countries, which is related to the parameters we are using for calibrating discount rates. We agree with a recent overview of this literature (Robinson *et al.*, 2019), and our results underscore their point, that 'more research [. . .] in low- and middle-income countries is essential.'

Alternative approaches

Although we focus on the consumption rate of discount as a benchmark for economic evaluations in global health, we do not dismiss the use of alternative approaches to strengthen aspects of the analysis. For example, if a researcher wishes to emphasize that much of the costs of an intervention would be refinanced by subsequent savings, the real interest rate on the government's costs of borrowing (also taking into consideration that concessional financing may be available) could be used. Furthermore, because the effects of some health interventions, such as cardiovascular risk prevention, or tobacco tax to reduce the burden of cancer) are spread over decades, like dams or other infrastructure investments—one could strengthen an economic argument for an investment in health by pointing out that it stands up well even if common criteria for the evaluation of investment projects are used. For interventions which are cost-saving when common standards are applied, the internal rate of return (i.e. the discount rate at which the savings just offset the costs) can be used to quantify economic returns.

Costing consistent with discounting

One aspect that is rarely recognized in health economic evaluations is the need to project costs in a way that is consistent with the assumptions on growth embodied in the discount rates. That is, it is necessary to consider how unit costs (in real terms) may change as GDP per capita rises. This point applies to public health in general, but it is particularly relevant in global health, engaging with countries experiencing relatively high rates of economic growth. Projecting costs in real terms is not the same as assuming constant prices. In particular, wages and salaries increase at about the same rate as GDP per capita. For the entire economy, this drift in unit costs from increasing wages and salaries is (more than) offset by increasing productivity. This process, though, does not necessarily carry over to health economic evaluations, because productivity growth in the health sector may be slower than for the economy overall (Nordhaus, 2008; Baumol, 2012), and economic evaluations in global health typically regards specific technologies with fixed properties rather than types of services subject to technological change.

Declining discount rates

We did not discuss so far the literature on applying discount rates which decline over the evaluation period. This practice is common in the literature on climate change, motivated by specific types of economic uncertainty, where it is applied to time horizons which may extend over centuries (see Arrow *et al.*, 2013, 2014; Cropper *et al.*, 2014). Proposed schedules of declining discount rates, though, would make little difference in the sphere of global health, where time horizons rarely exceed 3–5 decades, to accommodate the life cycle of the population targeted by a policy or to align with the time frames of global health policies.

Our analysis, though, suggests a different reason why discount rates may decline over the evaluation period. Because the discount rate is linked to the rate of economic growth, it should be reduced where there is good reason to believe that the rate of economic growth declines over the evaluation period, and vice versa. Figure 3 suggests that such drift is common as more advanced economies tend to have lower growth rates. That is, for developing economies catching up successfully, the rate of growth of GDP per capita and the applicable discount rate may decline as they close the gap to leading economies.

Equal vs differential discounting

Although much of the literature in health economics (see Table 1), grounded in the theory of social welfare and the microeconomic theory of consumption, suggests that health gains should be discounted at a lower rate than costs or financial gains ('differential' discounting), economic evaluation in global health predominantly apply equal discount rates. The latter practice is commonly motivated by alleged inconsistencies introduced in economic evaluations when different discount rates are applied (e.g. Weinstein and Stason 1977; Keeler and Cretin, 1983).

Our interpretation of this discourse is that the appropriate approach to discounting depends on the *purpose* of the evaluation (Gravelle and Smith, 2001; Claxton *et al.*, 2011). If the analysis is

geared towards the economic returns to health spending, then differential accounting is appropriate, as one method of capturing the increasing economic valuation of health gains over time. Usually, though, there are more explicit and transparent methods available for capturing the valuation of health over time (Fuchs and Zeckhauser, 1987).

If the purpose of the evaluation is to analyse the effectiveness of an intervention or policy in terms of attaining health outcomes per se, then equal discounting is appropriate. This follows because differential accounting is an instrument for accounting for changing economic valuations of health outcomes. If, in contrast, the question is how effective or cost-effective a policy is in averting deaths, infections or other adverse health events per se, then this valuation is irrelevant and improperly applying differential accounting indeed results in the inconsistencies describes in the literature.

Because the practice of equal discounting in health evaluation represents a departure from the utility-based theory of discounting for health outcomes outlined above, this theory does not provide explicit guidance for the choice of discount rates when equal discounting is applied. However, underpinnings of the social discount rate for consumption and costs are unaffected by the decisions on the discounting of health outcomes. To ensure consistency between cost-effectiveness analysis and the accounting for costs (applying theoretically validated discount rates for the latter), we propose that the social discount rate is used when equal discounting is applied.

Conclusions

We find that the social discount rate generally applied in global health of 3% annually is inconsistent with rates of economic growth experienced outside the most advance economies. For low- and lower-middle-income countries, a discount rate of at least 5% would be appropriate instead (and around 4% for upper-middle-income countries). Large variations in economic growth across LMICs imply that more consideration should be given to adopting country-specific discount rates. Depending on the purpose of an evaluation, other types of discount rates (those used typically for evaluating investment project, or one based on the costs of funds) could usefully be applied. In an environment with high rates of economic growth, it is important that assumptions on cost projections and on discounting are consistent. We do not make recommendations on 'equal' vs 'differential' discounting but describe it as a choice depending on the outcome of interest, and note that there are more explicit and transparent ways of modelling the increasing value of health increments.

Acknowledgements

T.B.H. acknowledges joint Centre funding from the UK Medical Research Council and Department for International Development (MR/R015600/1). No funding was received specifically for this work.

Conflict of interest statement. None declared.

Ethical approval. No ethical approval was required for this study.

References

Arrow K, Cropper M, Gollier C *et al*. 2013. Determining benefits and costs for future generations. *Science* **341**: 349–50.

Arrow KJ. 2000. A comment on Cooper. *World Bank Research Observer* **15**: 173–5.

Arrow KJ, Cropper ML, Gollier C *et al*. 2014. Should governments use a declining discount rate in project analysis? *Review of Environmental Economics and Policy* **8**: 145–63.

Attema AE, Brouwer WBF, Claxton K. 2018. Discounting in economic evaluations. *PharmacoEconomics* **36**: 745–58.

Baumol WJ. 1968. On the social rate of discount. *American Economic Review* **58**: 788–802.

Baumol WJ. 2012. *The Cost Disease*. New Haven and London: Yale University Press.

Brouwer WBF, Niessen LW, Postma MJ, Rutten FFH. 2005. Need for differential discounting of costs and health effects in cost-effectiveness analyses. *BMJ* **331**: 446–8.

Burgess DF, Zerbe RO. 2011. Appropriate discounting for benefit-cost analysis. *Journal of Benefit-Cost Analysis* **2**: 1.

Burgess DF, Zerbe RO. 2013. The most appropriate discount rate. *Journal of Benefit-Cost Analysis* **4**: 391–400.

Center for Evaluation of Value and Risk in Health (CEVR). 2019. *Global Health Cost Effectiveness Analysis Registry*. Boston MA: CEVR, Tufts Medical Center. http://healtheconomics.tuftsmedicalcenter.org/ghcearegistry/, accessed 18 January 2019.

Claxton K, Asaria M, Chansa C *et al*. 2019. Accounting for timing when assessing health-related policies. *Journal of Benefit-Cost Analysis* **10**: 73–105.

Claxton K, Paulden M, Gravelle H, Brouwer W, Culyer AJ. 2011. Discounting and decision making in the economic evaluation of health-care technologies. *Health Economics* **20**: 2–15.

Cleemput I, Neyt M, Van De Sande S, Thiry N. 2012. *Health Technology Assessment Belgian Guidelines for Economic Evaluations and Budget Impact Analyses*, 2nd edn. Brussels: Belgian Health Care Knowledge Center.

Council of Economic Advisors. 2017. Discounting for public policy: theory and recent evidence on the merits of updating the discount rate. *Council of Economic Advisers Issue Brief*. Washington, DC: Council of Economic Advisors.

Cropper ML, Freeman MC, Groom B, Pizer WA. 2014. Declining discount rates. *American Economic Review* **104**: 538–43.

Drupp M, Freeman M, Groom B, Nesje F. 2018. Discounting disentangled. *American Economic Journal: Economic Policy* **10**: 109–34.

European Commission. 2018. *Commission Implementing Regulation (EU) 2015/207 of 20 January 2015*. Amended and consolidated version of 25 February 2018. Luxembourg: Publications Office of the European Union.

Evans DJ. 2005. The elasticity of marginal utility of consumption: estimates for 20 OECD countries. *Fiscal Studies* **26**: 197–224.

Freeman M, Groom B, Spackman M. 2018. *Social Discount Rates for Cost-Benefit Analysis: A Report for HM Treasury*. https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent, accessed 16 September 2018.

Fuchs VR, Zeckhauser R. 1987. Valuing health—a 'priceless' commodity. *American Economic Review* **77**: 263–8.

Gold MR, Siegel JE, Russell LB, Weinstein MC. (eds). 1996. *Cost-Effectiveness in Health and Medicine*. Oxford and New York: Oxford University Press.

Gravelle H, Smith D. 2001. Discounting for health effects in cost-benefit and cost-effectiveness analysis. *Health Economics* **10**: 587–99.

Groom B, Maddison D. 2019. New estimates of the elasticity of marginal utility for the UK. *Environmental and Resource Economics* **72**: 1155–82.

Harberger A, Jenkins G. 2015. Musings on the social discount rate. *Journal of Benefit-Cost Analysis* **6**: 6–32.

Her Majesty's Treasury. 2018. *Central Government Guidance on Appraisal and Evaluation*. London: Her Majesty's Treasury.

International Monetary Fund (IMF). 2018. *World Economic Outlook Database*. October 2018 version, Washington, DC: IMF.

Keeler EB, Cretin S. 1983. Discounting of life-saving and other nonmonetary effects. *Management Science* **29**: 300–6.

Lipscomb J, Weinstein MC, Torrance GW. 1996. Time preference. In: Gold MR, Siegel JE, Russell LB, Weinstein MC (eds). *Cost-Effectiveness in Health and Medicine*. Oxford and New York: Oxford University Press.

Moore MA, Boardman AE, Vining AR. 2013. More appropriate discounting: the rate of social time preference and the value of the social discount rate. *Journal of Benefit-Cost Analysis* **4**: 1–16.

Neumann PJ, Ganiats TG, Russell LB, Sanders GD, Siegel JE. (eds). 2016. *Cost-Effectiveness in Health and Medicine*. Oxford and New York: Oxford University Press.

Nordhaus WD. 2008. Baumol's diseases: a macroeconomic perspective. *B.E. Journal of Macroeconomics* **8**: 9.

Office of Information and Regulatory Affairs (OIRA). 2011. *Regulatory Impact Analysis: A Primer*. Washington, DC: OIRA.

Parsonage M, Neuburger H. 1992. Discounting and health benefits. *Health Economics* **1**: 71–6.

Robinson LA, Hammitt JK, Cecchini M *et al*. 2019. *Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development*. Boston, MA: Center for Health Decision Science, Harvard T.H. Chan School of Public Health.

Robinson LA, Hammitt JK, O'Keeffe L. 2019. Valuing mortality risk reductions in global benefit-cost analysis. *Journal of Benefit-Cost Analysis* **10**: 15–50.

Sanders GD, Neumann PJ, Basu A *et al*. 2016. Recommendations for Conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. *JAMA* **316**: 1093–103. p

van Hout BA. 1998. Discounting costs and effects: a reconsideration. *Health Economics* **7**: 581–94.

Weinstein MC. 1996. Recommendations of the panel on cost-effectiveness in health and medicine. *JAMA* **276**: 1253–8.

Weinstein MC, Stason WB. 1977. Foundations of cost-effectiveness analysis for health and medical practices. *New England Journal of Medicine* **296**: 716–21.

Wilkinson T, Sculpher MJ, Claxton K *et al*. 2016. The international decision support initiative reference case for economic evaluation: an aid to thought. *Value in Health* **19**: 921–8.

Wilkinson T. *et al*. 2014. *Bill and Melinda Gates Foundation Methods for Economic Evaluation Project (MEEP): Final Report*. London: National Institute for Health and Clinical Excellence.

World Bank. 2018. *World Bank Country and Lending Groups For the Current 2019 Fiscal Year*. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, 18 January 2019.