Methodological appendix

This document summarizes the methodological guidelines used to undertake the cost-benefit analysis in the *Prioritizing the Best Buys for Development Across the African Continent* project.

The analyses undertaken by commissioned experts were primarily 'back-of-the-envelope'; some based on recent academic publications. The guidelines were issued as an attempt to homogenize the work done across sectors.

In keeping with the vision of the Sustainable Development Goals and the African Union Development Agenda 2063, and given additional funding, which interventions would render high social, economic and environmental returns on investment? This is the principal question of the project.

To answer it, the Copenhagen Consensus Center, in collaboration with sector experts and the African Academy of Sciences, commissioned back-of-envelope cost-benefit calculations of **20-30 interventions** across a variety of sectors. Some are African Union Flagship programmes, others are interventions that we know, from experience, have high returns.

The selection of interventions was a collaborative process: Drawing from our previous work and in keeping with the vision and objectives of the African Union Development Agenda 2063, there were various exchanges between the Center and the expert in order to arrive at the final selection of interventions to be studied.

The academic analysis is predicated on an **injection of new money** available to decision makers. This means that all cost-benefit analyses are prospective and should take the existing coverage of interventions as the baseline.

The project output is a synthesis report, compiling the policy briefs for each intervention.

Each brief describes the problem and the proposed intervention, an explanation of the cost drivers and probable benefits associated with the scaling-up of the intervention, and an estimation of the order of magnitude of benefits over costs. Lastly, a discussion of the implications of scale-up of the intervention; an identification of countries in which the intervention may be replicated with similar results and any risks/challenges associated with its expansion in countries other than those under analysis; all of which will form part of each brief.

Introduction

As we enter the last decade to achieve the Sustainable Development Goals (SDGs), countries still face major challenges to ensuring that all people have the opportunity to lead healthy lives and reach their full potential. This is especially true in Africa, where many countries have the farthest to go to meet targets for health and wellbeing. The SDGs, along with the African Union's Development Agenda 2063 and national development plans, lay out a huge number of health and development priorities for countries to tackle in pursuit of those targets. Recognizing that time and resources are limited, it is essential to prioritize and focus on the areas that offer the greatest opportunity for impact.

Looking at the scientific priorities set by the SDGs, African Union Agenda 2063, and national development plans, which will give African countries the greatest return on investment?

The scope of problems across the continent far exceeds the resources available to address them. As such, this requires hard choices about where to invest first. One organizing principle, though by no means the only one, is that coordinative efforts should spend money on interventions that deliver the largest amount of social, environmental and economic good to African citizens for every unit of investment.

The Copenhagen Consensus' mission is to influence spending towards interventions and policies that do more good per unit of currency spent.

Cost-benefit analysis (CBA),[120] also referred to as benefit-cost analysis, is a well-established formal method for identifying interventions that maximize social welfare per unit cost, and is the primary methodology of the Copenhagen Consensus Center. Conceptually, the process of CBA is straightforward: an analyst identifies a given policy and estimates the impacts of this policy relative to a baseline scenario. These marginal impacts are classified into costs and benefits (more on this classification below), and converted into a common metric, typically into the local currency. All results are summarized as a benefit-cost ratio (BCR: benefits divided by costs).[121]

Theory of Change

All Copenhagen Consensus exercises are processes designed to inject more rationality into the debate around doing good for the world. Investments in highly beneficial interventions increases the likelihood that government and philanthropic spending becomes more effective on average. Because the influenceable pool of money is very large, even small changes in allocation can improve effectiveness and hence large improvements in social welfare.

For example, Figure 1 below depicts the span of BCRs from the recent *Rajasthan Priorities* project. The top intervention has a BCR of around 180, the median intervention a BCR of 4.5 and the lowest intervention a BCR of 0.9. Because our process aims to filter out very ineffective interventions before they are researched, it is possible the true distribution is 1 or 2 orders of magnitude wider at the lower end.

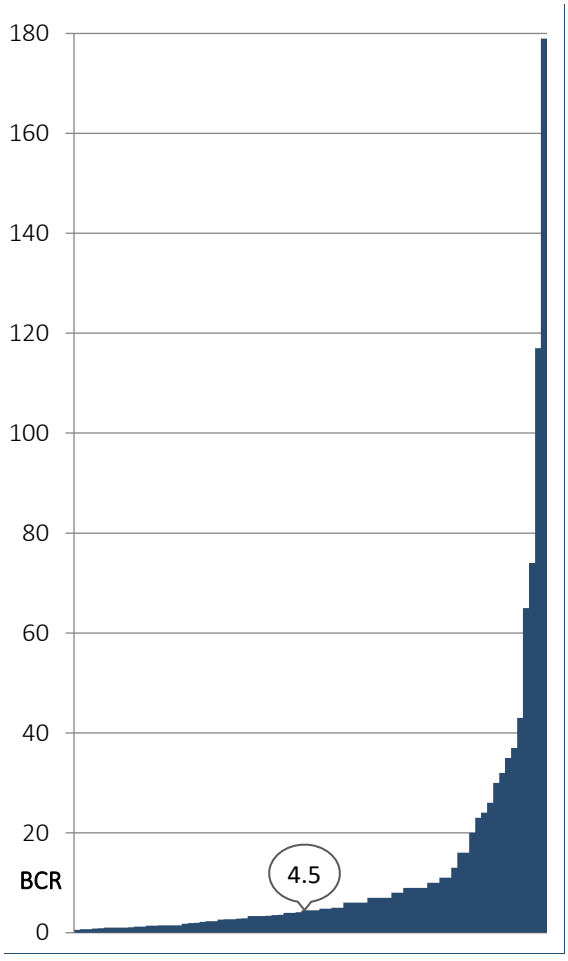
The implication of this large dispersion of effectiveness is that we focus on identifying the interventions at the top of the distribution and push strongly for their implementation. This is likely to be a superior strategy than making marginal improvements in existing interventions. In the case of the *Rajasthan Priorities* project, a decision maker with 100 rupees could spend 5% of her money on the top intervention and generate more social welfare than spending the remaining 95% on programs that are twice as efficient as the median intervention.

[120] Copenhagen Consensus conducts social CBAs. The 'social' aspect signals that the cost-benefit analysis accounts for and aggregates the costs and benefits of *all* relevant parties who are affected by the policy, and is distinct from 'private' cost-benefit analysis, which only concerns the impacts on a single party.

[121] Results of CBA can also be summarized in other ways, such as net benefits, internal rate of return or payback period. Copenhagen Consensus' preferred metric is the BCR as described below.

The implications of this for Copenhagen Consensus projects is that it is important that we canvas a wide range of policy options to increase the chances of finding these outliers. Additionally, given that the dispersion is so large, a high degree of precision is not typically required to identify outliers. While of course more precision is preferred to less, it is unlikely for example, that deeply investigating a particular methodological issue that will move an intervention from say, a BCR of 2.2 to 3.7 is required to achieve our aims.

COUNTRY-SPECIFIC INTERVENTIONS ORDERED FROM THE LOWEST BCR TO HIGHEST BCR



Source: Rajasthan Priorities project. The median intervention with BCR of 4.5 is highlighted.

For our country-level analysis, we like to survey a vast array of policy options, typically numbering 60 - 80 interventions. However, due to limited time for preparation, consultation and analysis, the *Prioritizing the Best Buys for Development Across the African Continent* project is limited to 20 - 30 interventions. Our experience informs us that some sectors will have several interventions, given the actual needs in human capital investment on the African continent and the high returns that can be expected due to reductions in mortality and morbidity. For example, the health sector has interventions addressing the lack of access to diagnostics and health personnel, infectious diseases like HIV and TB, chronic diseases like hypertension, malnutrition, maternal and neonatal health concerns, and the top causes of child and adult mortality (i.e. diarrhoea and gastrointestinal disorders and lower respiratory infections. All of this notwithstanding, we have identified other sectors in which high returns may be expected, either because they remove barriers to entry and make markets more efficient (e.g. Africa Continent Free Trade Area) or because technology reduces the costs of production (e.g. investment in additional R&D to increase agricultural output).

Academic exercise

The academic exercise of the *Prioritizing the Best Buys for Development Across the African Continent* project is premised on an **injection of new money available to decision makers**, that can only be spent on expanded or new programs. The specific amount is unimportant and conceptually, it only needs to be large enough to cover a reasonable amount of new projects but not so large that it would significantly distort prices in the relevant national economies.

Importantly, **because the money is new**, it implies:

1. the baseline for all CBAs is the existing absolute coverage level of interventions i.e. resources are not being taken away from what is currently being done
2. the CBAs are a prospective analysis of future expansions of existing programs, or standing up wholly new programs, and not an evaluation of past efforts

This feature is designed to conform to the economic concept of marginal analysis and it also assists in outreach and communication. Since one cannot use our results to predict what would happen if **existing** money was redistributed across portfolios, only what would happen with hypothetical **new** money, it

makes the exercise more politically palatable for decision makers and bureaucrats, increasing the chance that the information will be used.

It is important that economists are clear about the baseline scenario assumptions. The approach of considering only marginal money, suggests that the absolute coverage level of interventions is the baseline, with additional expansions (either due to population growth or expanding the scope of beneficiaries) subject to cost-benefit analysis. In terms of the problem being addressed by the intervention, the economist should estimate a baseline that is consistent with previous trends noting the main drivers of the problem (e.g. demographic transition, wealth, disease transmission etc…).

The unit of analysis in all our projects is an 'intervention'. **An intervention is a specific, concrete and time bound action that can be taken by policy makers** such as '*provide more TB screening and treatment*' or '*allow inter-country free movement of people'*. It is not an aspiration without means, e.g. '*eliminate poverty'*. Interventions are typically subset of wider of programs implemented by governments. For example "providing supplementary foods to mothers and children" is one intervention in the wider Integrated Child Development Services programme in India. **Our focus is generally at the intervention level, and not the programme or mission level.** Papers may cover one or more interventions according to the preferences, availability and expertise of the commissioned experts, and the interventions may fall under a particular programme, but the exercise should not be considered a programme evaluation.

There are some assumptions/data common to all analyses. **We encourage commissioned economists to refer to Section 5** for the most prominent assumptions that will be used in the *Prioritizing the Best Buys for Development Across the African Continent* project, as well as in the attached template.

To remain cost-effective, the Copenhagen Consensus encourages researchers to use existing primary data and to focus more on **generating consistent and comparable information for policy makers.** Consequently, there is no expectation that researchers will survey individuals, conduct experiments or engage in time-intensive data collection, without the express permission of the Copenhagen Consensus.

Methodological Guidelines

There are numerous textbooks that go deeper into the theoretical foundations of CBA and methods (e.g. Boardman et al., 2018) as well as guidelines that more fully lay out the steps of CBA (e.g. Robinson et al. 2019). These will not be re-explained here. Nevertheless, there are important, sometimes subtle methodological differences in how CBA is conducted by practitioners within the field. This section delves into some of the details of the Copenhagen Consensus approach to CBA.

Use of evidence

One of the main analytical challenges is discerning the appropriate evidence as it relates to the beneficiary population in question. Determining which models to adapt can be a complex judgment that should consider contextual relevance, study quality, and literature consistency. For this project, it is clear that preference should be given to high quality analyses from Sub-Saharan Africa, followed by other developing countries having similar socio-economic and demographic conditions. Use of effect sizes from carefully conducted meta-analyses is, of course, also encouraged. However, when the most contextually relevant studies have less robust experimental designs or the literature is divergent in its conclusions, then the parameter choice is less straightforward.

Overall, it is important that economists build a case for the parameters used in the broad calculations, referring to the literature for assumptions used.

Estimating all significant costs and benefits

Meaningful comparisons across interventions requires that all significant costs and benefits are accounted for. In some cases, this will be difficult to achieve due to imprecision or lack of data. In the case of the *Prioritizing the Best Buys*

for Development Across the African Continent project, the challenge is in estimating costs and benefits for a number of countries. Nevertheless, we encourage commissioned experts to make an attempt to estimate these costs and benefits, rather than leaving them off altogether.

We also encourage experts to include estimates of all costs and benefits that are likely to be significant in the analysis. This might entail examining benefits outside the primary aim of the intervention. For instance, when looking at climate change adaptation by planting mangroves, the benefit is not just climate protection, but also improved biodiversity and potential higher incomes to fishers. Likewise, an education intervention will not just increase earnings but will also improve nutritional profiles.

BCR vs. net benefits

While many CBAs highlight net benefits (B minus C), our preferred metric is the benefit-cost ratio (BCR), which is benefit (B) divided by cost (C). The reason for this is that in developing country contexts the ability to raise funds (through taxation or debt), or the ability to enforce regulation is constrained. This is perhaps different to developed countries, which can typically raise money and legislate with much greater ease. Given a fixed pool of available funds (as is the case in our 'thought experiment' set up, as well as in actual political decision making), a strategy that begins with implementing the highest BCR intervention and continues in decreasing order until money runs out will maximize social welfare. A strategy that starts with the highest net benefits intervention continuing in decreasing order, almost certainly will not.

For example, suppose a policy maker has $100 and is faced with the following options

	Benefits	Costs	Net Benefits	BCR
Policy A	$300	$100	$200	3
Policy B	$240	$60	$180	4
Policy C	$200	$40	$160	5

If the policy maker chooses based on the intervention with the highest net benefits, then she would choose policy A, run out of money and generate net benefits of $200. However, if ranked on BCR, she would implement policy C, and then policy B, before running out of money. This would generate $340 in net benefits.

Classification of costs and benefits

It is important that costs and benefits are classified consistently to ensure comparable BCRs. Robinson et al. (2019), suggest that inputs into a process (such as materials and labor) should be classified as costs, while outcomes (such as mortality risk reductions or increased productivity) should be classified as benefits. This approach is intuitive, and we generally ascribe to this methodology.

What should be included on the side of the cost equation? The total costs associated with the design and implementation of an intervention includes direct and indirect costs, as well as the opportunity cost. Take for example, an intervention to end child labour in India. The National Child Labour Project, has as its principal objective the decrease in the number of working children, ages 9 - 14, and particularly those engaged in hazardous occupations. One of the interventions associated with this programme is the establishment of special schools and rehabilitation centres, which provide bridge education, vocational training, mid-day meals, health care recreation etc. to the children, with the ultimate objective of preparing them to be mainstreamed into the formal education system.

A cost-benefit analysis of these special schools must take into account the capital costs (e.g. building construction) and the recurrent costs of making education and health services available (e.g. teachers, nurses, pedagogic materials). There is also the *opportunity cost* of the intervention: the foregone income to the household from child employment. The children's financial contributions to households being considerable, adding a small stipend to subsidize household expenditures, rather than assuming that the returns to education are sufficiently high, mitigates the next best alternative, which is sending the child to work. The National Child Labour Project does indeed include a stipend to families. In this case, an estimation of the foregone income would be

added to the cost side. Neglecting the opportunity costs of an intervention can not only result in sub-optimal financing but also the mis-targeting of beneficiaries, consequently undermining its success.

What should be included on the benefit side of the equation? In order to adequately capture the benefits of a proposed intervention, the beneficiary groups must be well-identified. It does not suffice to identify just women as beneficiaries: Are they living in rural or urban areas? Which age group is targeted? Which ethnic/social groups? Does marital status impact the delivery of the intervention? The more defined the beneficiary group, the more precise our estimates, the more likely planners will be able to adjust the intervention in order to maximize its effectiveness.

Furthermore, an intervention, which leads to cost reductions, should be included on the benefit side of the equation. Take, for example, the adoption and integration of information technology in government operations. Generally, the benefits of such interventions include a reduction in service delivery costs including fewer public servants needed to render services (a benefit); a time savings experienced by citizens using the service (a benefit), and a reduction in the number of times a citizen has to travel to a public office (also a benefit).

An additional principle we employ is that **absolute** benefits and costs should be considered where possible, with **no netting off benefits or costs**. For example if agricultural extension services cost $5 and this leads to increased farm revenue of $45, yet also increased farm costs of $10, we would estimate the benefits as $45, and the costs as $5 + $10 = $15 for a BCR of 3. We would **not** net off the revenue and costs (i.e. profit) for benefits of $35, costs of $5 and a BCR of 7. The reason for this is that the true resource cost of the intervention – the amount that is consumed from the fixed pool of funds available to society is $15 and not $5, and so the result from the first approach better captures the return on investment.

Treatment of transfers

Interventions involving transfers are an area where consistent classification matters greatly. Transfers tend to fall under the field of social protection and include unconditional cash transfers, conditional cash transfers, food transfers and subsidized insurance. In this case, the transfer appears as both a cost and a benefit in the BCR equation. It should **not** be netted out. For example, consider an unconditional cash transfer of $100. Suppose the administrative costs of delivering the transfer are $5 while the transfer delivers consumption-smoothing benefits of $10 to recipients. In this case, the benefits are $110, while the costs are $105 for a BCR of 1.04. If one were to net out the transfer (incorrectly), the intervention would appear as benefit = $10 and cost = $5 for a BCR of 2. However, as above, the real resource cost of the intervention is $105, not $5, so 1.04 is, in our estimation, more accurate reflection of the social return.

Time frame of analysis

In terms of the appropriate time frame of analysis, there is one principle: the time frame should be long enough to capture the most important future flow-on effects (typically benefits, but sometimes also costs) from a given intervention. The exact length will vary by analysis. For example, since infrastructure lasts for decades, CBAs of roads, public transport, sewage networks and other major capital works should take at least a 20 year (or more) time horizon to capture all the benefits. In contrast, the costs and benefits of say, crop insurance can be modeled as a one year steady-state intervention, since typically insurance covers only that year's crop, with next year's insurance covering next year's crop and so on.[122] Importantly, as long as the time frame used captures all material flow-on effects,

[122] That is not meant to imply that individuals do not take multiple years of insurance. However, modeling multiple years of crop insurance will not lead to materially different BCRs than a one year model, since the costs (premiums) and effects (insurance benefits) occur within a one year time frame.

differences in time do not affect the comparability of interventions when using benefit-cost ratio as the metric of interest.[123]

The analytical base year is 2018

For those economists not working from peer-reviewed publication and/or working on an entirely new intervention, the analytical base year for the *Prioritizing the Best Buys for Development Across the African Continent* project is 2018. This means that all costs and benefits should be reported in 2018 United States dollars. Costs sourced from earlier years should be inflated to the analytical base year using a GDP inflation index, though it is discouraged, when it can be avoided, to use data before 2016. Additionally, forecasts of costs and benefits only need to account for real growth and should ignore inflation. Additionally, all interventions should take the initial conditions of the year 2018 (or as recently as data allows) and assess the effects against this baseline.

Political considerations

All political costs regarding *the decision to implement* should be ignored, while political fall-out *in actual implementation* should be considered. In other words, all cost-benefit analyses should take as a starting point the hypothetical scenario where the decision is already made to implement the intervention. Costs associated with advocacy, campaigning, etc. to encourage implementation should be ignored. However, if the completed decision may make politicians decide to cheat or skim the process, this simply means a smaller benefit or a larger cost and should be included (along with all other risks, and challenges in implementation).

The concept of risk

BCR estimates should be revised downward to incorporate well-documented assessments of risk. For example, where it relates to microfinance, it is generally recognized that 2% of borrowers are at risk of default. This risk should be worked into the calculations; in this case, it is an additional cost to the lender.

Implementation failures

To the extent that the data allows, commissioned economists should account for implementation failures such as corruption and incompetence. The most straightforward way to account for this is to adopt parameter estimates from studies with high quality methods (e.g. randomized-controlled trial, difference-in-difference, regression discontinuity) which should theoretically embed all the vagaries of implementation into the effect size. However, recent literature around RCTs documents divergence between small-scale pilots and real-world implementation. In disciplines where these studies are not possible or uncommon, we suggest carefully considering to what extent the evidence represents ideal or non-realistic scenarios with respect to the actual local context and adjust accordingly.

Equity weights

As with most CBAs, as traditionally adopted, Copenhagen Consensus assigns an equal weighting to all costs and benefits regardless of who obtains or pays them. The one exception is for individuals who illegally obtained assets via corruption or theft, which we assign a weight of zero. So for example, in an intervention which reduces corruption, the loss of corrupted funds does not count as a cost in the societal cost-benefit calculation.

Jobs vs. output

Cost-benefit analysis, as is traditionally adopted, does not count the creation of jobs as a benefit. Instead the focus should be on the flow on effects of job creation – either output, income or consumption. The primary reason the value of jobs differs depending on the state of the labor market in question, and this is better determined by examining flow-on

[123] Referring back to the examples above: one might feel it is more appropriate to compare a 20 year road project to 20 years of crop insurance. However, 20 years of crop insurance will have approximately the same BCR as one year of crop insurance, since 20 years of crop insurance is just one year of insurance repeated 20 times i.e. BCR = 20 x benefits / 20 x costs = 1 x benefits / 1 x costs.

effects (the increase in output or the increase in incomes) rather than the monetary value of the number of jobs created.

If the intervention under analysis specifically targets job creation – such as a workfare program like India's rural guarantee scheme – economists need to examine the broader general equilibrium effects to understand the impact in a cost-benefit framework.

Important common assumptions and approaches for Prioritizing the Best Buys for Development Across the African Continent project

Wages and wage forecasts

Wages and wage forecasts are required for estimating productivity and education benefits as well as time costs / benefits. The Center encourages the use of GNI per capita forecasts where:

> Wages = GNI per capita * labor force participation * labor share of income

GNI per capita and GNI per capita growth for all Sub-Saharan African countries were distributed to experts.

Discount rates

We acknowledge there is considerable debate around the appropriate discount rate to use in economics, as well as the fact that discount rates differ with country context. Considering that we are analyzing countries at various stages of development, we would like experts to report BCRs at 5%.

Valuing mortality and morbidity

Valuations of mortality and morbidity follow recent guidelines developed under the Harvard led *Guidelines for Conducting Benefit-Cost Analysis* project (Robinson et al. 2019). These guidelines suggest a range of approaches. Given time constraints, we adopt one of these approaches for this project. Copenhagen Consensus' preferred approach is to convert each death avoided into years of life lost (YLL) avoided, using the relevant life tables, and to value each YLL at 1.3x GNI per capita. YLLs should not be discounted.

This preferred approach was derived by taking a VSL value of $9.4m USD (2015 dollars) – representing approximately 160 times income as measured by income per capita PPP - transferred to the continent using an income elasticity of 1.5. In 2017, GNI per capita PPP for sub-Saharan Africa was Int$3700 while the corresponding value for the US was Int$61,120 (World Bank, 2019). Using these figures and applying the approach documented in Robinson et al. (2019) suggests a VSL to GNI per capita multiplier of approximately 39x for the continent.[124]

Life years are valued using a constant value of statistical life year (VSLY). A VSLY is typically derived by dividing the VSL by the average life expectancy of an adult of average age, proxied by half the life expectancy at birth. In sub-Saharan Africa, life expectancy at birth is 61 (World Bank, 2019), implying 30.5-year life expectancy for an adult of average age. The value of a YLL therefore, as a function of GNI per capita is 39 / 30.5 = 1.3.

In terms of morbidity avoided, the *Guidelines* recommend adopting a cost-of-illness approach. However, this approach can be very data intensive. For parsimony, we suggest here estimating the Years of Life Lost to Disability (YLDs) avoided from morbidity benefits, and applying the same multiplier for YLLs i.e. 1.3xGNI per capita.

In summary all DALYs (whether YLLs or YLDs) should be valued at 1.3xGNI per capita and not discounted.

Value of time

Following Whittington and Cook (2019), we assess the value of time which can be put to use for productive purposes at 100% of wages, while time that cannot be applied to productive purposes is valued at 50% wages for the population in question. Analysts should be careful to include the cost of time required to

[124] The exact calculation is (3700/61,120)^(1.5-1)*160.

access the services provided by interventions, particularly for health programs.

In some instances, economists will have to value time of children. While there appears to be no agreed consensus on appropriate valuation, it seems reasonable that i) the value should be lower than productive adult's time and ii) very young children probably have a zero or even negative value of time (e.g. if children are not at school, adult caregivers are required). So we suggest applying a value of zero for the time of children less than 10 years old. This is consistent with the returns to education literature (e.g. Psacharopolous and Patrinos, 2018), which does not apply an opportunity cost of attending primary school before grade 5. For children aged 11 to 15, a value somewhere between children's and adult's time should be applied depending on the context, and potentially reflecting the value that children might contribute to agricultural activities or factory work. Individuals aged 16 and above should be considered adults.

Value of carbon emissions avoided

The value of carbon emissions avoided is drawn from a recent review of the social cost of carbon literature (Tol, 2018). According to this review, the marginal value of a ton of CO_2-eq avoided varies by discount rate. For a 3% discount rate the value is USD 25.30 / ton while for a 5% discount rate it is USD 7.60 / ton. Both figures are denominated in 2010 USD. For much higher discount rates, the effective value of carbon emissions avoided at USD 0 / ton.

To estimate the value of carbon emissions reduction also requires a growth factor in the social cost of carbon emissions, since the social cost grows over time as more CO_2-eq is released into the atmosphere. The growth factor should be set at 2% as per year (Tol, 2018). The equation for calculating the benefit of avoided carbon emissions is therefore:

$$Benefit = \sum_{t=0}^{n} \left[\frac{SCC_t(1 \times g)^n}{(1+r)^n}\right]$$

where *t=0* represents the year 2015, SCC is the social cost of carbon above in 2010 USD (note in Tol (2018) the emissions year and the currency year are different), g = 2%, r = discount rate.

Treatment of costs of raising funds

In some CBAs, analysts explicitly include the cost of raising funds or the cost of taxation. This is usually assessed as a fixed cost per dollar of investment. We recommend ignoring this in CBA since it affects all analyses approximately equally. The inclusion of this cost would add complexity without improving precision or our ability to identify outliers.

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