Turning the paradigm of aid allocation on its head

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ABSTRACT

How should aid be allocated among countries? Past research efforts to answer this question followed three steps: (1) the definition of an objective function; (2) the characterization of its functional form; and (3) the estimation of its parameters. Each step has been heavily criticized. While thought provoking, all attempts to refine the objective function and its functional form have increased complexity, overburdening the already too fragile parameterization step. We argue that a complete rethinking and reversal of this paradigm is needed. We start by examining what can be estimated with “sufficient” credibility. We then define five key properties or axioms which are justified in terms of fairness, proportionality, and encouragement domestic investments. Finally, we combine these elements into an allocation formula. The framework is applied to the allocation of development assistance for health.

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SECTION 1. INTRODUCTION

The bulk of academic research on development aid is descriptive, aiming at identifying empirically the determinants of aid allocation or assessing the impact of development interventions on socio-economic outcomes. In contrast, normative research on how to allocate development aid is surprisingly scarce. To be sure, the absence of normative research does not reflect that a consensus on the question has already emerged, far from it. As put by Anderson and Waddington (2007), there has been “continued disagreement about which criteria should be used in determining the cross-country aid allocations”.

Thus far, normative research on how aid should be allocated has been built around the pioneering work of Collier and Dollar (2001, 2002; CD henceforth), as further detailed in Section 2. CD propose to allocate aid to countries to maximize poverty reduction. Using a growth regression, they estimate that aid is more efficient at reducing poverty when government effectiveness is higher. According to CD’s framework, aid should therefore be allocated in priority to countries that are poor and well governed.

In later research, CD’s “poverty-efficient” framework has been criticized on three grounds. We add a fourth critique. The first critique is normative and pertains to CD’s objective function, which is said to be short-sighted since it ignores future poverty (Wood, 2008), and unfair because it is not egalitarian² (Cogneau and Naudet, 2007) and it penalizes poor people living in countries with bad policies (McGillivray, 2004). The second critique focuses on the functional form of the growth regression that CD estimate, which was qualified as “reductionist” (McGillivray and Pham, forthcoming) and “narrow” (Cogneau and Naudet, 2007) since it omits many factors that can influence aid effectiveness in addition to the policy context. The third critique is empirical, as the estimation of the growth equation has proven to be fragile (Lensink and White, 2000; Easterly, 2003). Our fourth critique is that CD’s allocation formula does not explicitly distinguish needs (i.e., more poverty) from the domestic capacity of recipient countries. Richer countries with higher needs are therefore not held accountable for failing to invest in development outcomes beneficial to all their citizens. Instead, they can even receive more aid if their policy environment is relatively good.

A number of authors extended CD’s framework to account for the first two critiques. On the first critique, Llavador and Roemer (2001) and Cogneau and Naudet (2007) propose to equalize growth opportunities among recipient countries rather than to maximize growth. Wood (2008) further argues that donors are forward-looking and should therefore minimize the discounted sum of future poverty. Focusing on the second

²The framework is not egalitarian, in the sense that “no attempt is made to equalize an individual or national parameter” (Cogneau and Naudet, 2007) or to “compensate for unjust inequality deriving from circumstances” (Cogneau and Naudet, 2007).
critique, Guillaumont et al. (forthcoming) develop an allocation framework that accounts for vulnerability and human capital.

While pertinent, the frameworks building on CD do not respond to the third and the fourth critiques. In fact, the implementation of these more complex frameworks relies even more heavily on demanding econometric estimates and parameterization. None of these frameworks explicitly takes into account the financial capacity of recipient countries.

With these limitations in mind, this paper builds a new framework for the allocation of aid. To mitigate the third and fourth critiques, we argue that a complete rethinking and reversal of the mainstream approach is needed. Instead of defining an objective function, struggling to evaluate its functional form and parameters, and obtaining an allocation formula that fails to satisfy desired properties, we turn this paradigm on its head: we start by examining what can be estimated with “sufficient” credibility (Section 3); we then define desired properties – or axioms – that the allocation framework should satisfy (Section 4); and finally, we combine these elements into an allocation formula (Section 5). Our allocation framework relies on five axioms: (i) needs: everything else being equal, countries with strictly higher needs should not receive less aid per capita; (ii) financial capacity: everything else being equal, countries with strictly higher domestic capacity should not receive more aid per capita; (iii) level of aid: for effective countries displaying the desired level of domestic effort, aid should top up government expenditure to fund the costs of necessary investments in the development objective; (iv) domestic financing: the allocation formula should encourage domestic contribution of recipient countries targeted at the objective; and (v) proportionality: the elasticity of aid with respect to effort is equal to 1. The framework and its axioms can be easily adapted to specific normative viewpoints of international agencies and researchers.

In Section 6, we apply the general framework to the allocation of development assistance for health (DAH). We analyze how much DAH countries would receive with our framework and calculate the total amount of DAH under different scenarios. There is indeed scope for improvement in resource allocation for health based on transparent and explicit criteria (Ottersen et al., 2013), as studies find a lack of alignment between disease burden and funding (Dieleman et al. 2014). Ravishankar et al. (2009) highlight this discrepancy by reporting a “33-fold difference between DAH received by Turkmenistan and Nicaragua, two countries with similar disease burden”. International agencies in health have recently expressed their willingness to reflect on their allocation mechanisms, as demonstrated by the Equitable Access Initiative.\(^3\)

\(^3\)The Equitable Access Initiative (EAI) consists of nine major international agencies in health (the World Health Organization; the World Bank; Gavi, The Vaccine Alliance; UNAIDS; UNICEF; UNDP; UNFPA; UNITAID; and the Global Fund). It “aims to develop a health framework based on a broader set of
We further address the general applicability of our framework to other sectors of aid, such as education or poverty relief in the concluding section (Section 7).

**SECTION 2. CRITICAL REVIEW OF EXISTING FRAMEWORKS**

The allocation framework of CD and the papers built on this approach consist of three core elements: (1) the definition of an objective function; (2) the definition of its functional form; and (3) the estimation of its parameters. To each element corresponds one critique mentioned in the introduction and further expounded below.

The objective function of CD (2001, 2002) minimizes current poverty. Formally, they propose to distribute a total amount of aid \( \bar{A} \) in \( t=0 \) to foster countries’ economic growth such as to minimize aggregate poverty in \( t=1 \):

\[
\min_{\bar{A}_{i0}} \sum_i H_{i1} \iff \max_{\bar{A}_{i0}} \sum_i \alpha_i g_{i1} H_{i0}
\]

subject to: \( \sum_i A_{i0} = \bar{A} \)

where subscript \( i \) identifies countries and subscript \( t \) identifies times periods, \( A_{i0} \)= total aid, \( H_{i1} \)= total poverty, \( \alpha_i \)=elasticity of poverty reduction with respect to income, \( g_{i1} \)= growth of income per capita, \( \bar{A} \)= total aid to be allocated. In the second step, CD postulate that income growth is a non-linear function of aid and policy environment:

\[
g_{i1} = c + b_1 X_{i1} + b_2 P_{i0} + b_3 \left( \frac{A_{i0}}{Y_{i0}} \right) + b_4 \left( \frac{A_{i0}}{Y_{i0}} \right)^2 + b_5 \left( \frac{A_{i0}}{Y_{i0}} \right) \times P_{i0} + u_{i0}
\]

where \( Y_{i0} \)= total GDP, \( P_{i0} \)= the level of policy and \( X_{i1} \)= exogenous conditions. Combining equations (1) and (2), the solution of the maximization program is straightforward to derive:

\[
A_{i0} = -\frac{Y_{i0}}{2b_3} \left\{ b_3 + b_5 P_{i0} - \frac{\lambda Y_{i0}}{\alpha_i H_{i1}} \right\}
\]

where \( \lambda \) is the shadow value of aid.

The last step is to estimate the parameters of this equation. CD assume that the elasticity \( \alpha_i \) is constant across countries and equal to 2. The parameters \( b_3, b_4 \) and \( b_5 \) are evaluated by estimating the growth equation (2) using a panel dataset. CD’s estimates suggest that \( b_4 \) is negative, implying diminishing marginal returns to aid. Their estimate of \( b_5 \) is positive, suggesting that aid is more efficient in a good policy environment. From equation (3), they conclude that aid should be higher in countries with good policy and high initial poverty.

The framework of CD has been criticized on three grounds. First, from a normative perspective, the objective function of CD is “debatable in terms of fairness” because “it allows the persistence of big inequalities in poverty risk between people living in countries whose structural disadvantages are very different” (Cogneau and Naudet, 2007). Countries with bad policies and the poor people living in them are clearly penalized economic and health indicators to better inform decision making on health and development”, see [http://www.theglobalfund.org/en/equitableaccessinitiative/](http://www.theglobalfund.org/en/equitableaccessinitiative/).
(McGillivray, 2004). This critique reflects the “uncomfortable trade-off between need and effectiveness” (McGillivray and Pham, forthcoming) and the “fundamental disagreement about what is meant by a fair or equitable allocation” (Anderson and Waddington, 2007).

In response to this critique, the frameworks of Llavador and Roemer (2001) and Cogneau and Naudet (2007) propose to equalize growth opportunities among recipient countries. Anchored in theories of justice, their frameworks distinguish between a country’s effort, which is within its control and should be rewarded, and circumstances, which are beyond a country’s control and should be compensated for. Formally, the objective is to equalize the part of expected poverty at date T that is “purely circumstantial” and “effort-free”. The equalization process follows Rawls’ minimax system, as recommended by Roemer (1998).

\[
\min_{\sum_i H^e_{it}} \sum_i A_{i0} \\
\text{subject to: } \sum_i A_{i0} = \bar{A}
\]

The expected poverty \(H^e_{it}\) is a function of aid, which looks similar to equation (2). However, \(H^e_{it}\) depends on ex-ante expected effort and growth, contrary to ex-post poverty \(H_{it}\) which is a function of ex-post observed effort and growth (Cogneau and Naudet, 2007).

Another normative critique was offered by Wood (2008), who argues that “[…] donors and people care—for intellectually and morally defensible reasons—about both current and future levels of poverty”. However, CD’s framework mistakenly focuses on reducing current poverty, rather than the discounted flow of future poverty. In response, Wood (2008) proposes to minimize the discounted sum of future poverty, such that equation (1) is replaced by the following objective function:

\[
\min_{\sum_i A_{i0}} \sum_i \frac{H_{it}(A_{i0})}{(1+r)^T}
\]

The second critique of the framework of CD relates to its operationalization. As put by Wood (2008), “to operationalize any allocation model, it is clearly necessary to choose a specific form, but the choice matters greatly for the results”. The growth equation of CD was criticized for being “reductionist” and not “sufficiently nuanced” (McGillivray et al., 2016), assuming that “aid can only reduce poverty by increasing growth” (Lensink and White, 2000), and “ignoring a lack of human capital and economic vulnerability in recipient countries” (McGillivray et al., 2016). A few scholars proposed various avenues for generalizing equation (2) in response to this critique. For example, Guillaumont et al. (forthcoming) expand equation (2) to account for the impact of aid, economic vulnerability, human capital and their interactions on growth.

The third critique relates to the estimation of models’ parameters. Panel data analyses of the relationship between aid and growth – i.e., equation (2) – yielded fragile and ambiguous results (see e.g. Easterly, 2003; Bourguignon & Sundberg, 2007). As rightly summarized by Wood (2008), “there is much disagreement about the effects of aid on
poverty reduction: how big, how rapid, and conditional on what characteristics of recipient countries, aid instruments, and donor behaviour?” We formalize this empirical challenge, building on a general model in which countries invest efforts to improve a development outcome \( d_{it} \). This outcome depends on a country's effort, circumstances and income as well as on the level of aid that it receives. Effort and circumstances are difficult to measure. The observable part of these variables is labeled with a superscript \( o \). The unobservable part is labeled with superscript \( u \). In equation (6) summarizes this general model:

\[
d_{it+1} = d(Y_{it}, e^o_{it}, c^o_{it}, c^u_{it}, a_{it})
\]

(6)

where \( y_{it} = \) income per capita, \( a_{it} = \) aid per capita, \( e^i_{it} = \) effort, \( c^i_{it} = \) circumstances. Circumstances may include the lagged outcome variable \( d_{it} \). The distribution of \( e^u_{it} \) and \( c^u_{it} \) is unknown.

Equation (6) is a general form of equation (2). This equation is expected to be difficult to estimate for three main reasons. First, the estimation of equation (6) is subject to the usual endogeneity issues of omitted variables, reverse causality and mismeasurement (Rajan & Subramanian, 2008; Clemens et al., 2012; Museru et al., 2013). Because unobserved variation is likely to vary over time, estimations including fixed effects are also expected to be biased. In this context, randomization is impossible, and finding credible instrumental variables for all factors interacting with aid in equation (6) is illusory. Second, many variables entering in equation (6) are unobservable. Basic econometrics teaches us that the variance of the OLS estimator is proportional to the variance of the error term, which is expected to be massive in this case. Finally, the functional form of equation (6) is unknown (Clemens et al., 2012; Dalgaard & H. Hansen, 2001; Hansen & Tarp, 2001). The difficulty of estimating this functional form using theory or data mining is magnified by the first difficulty, that is, the fact that many variables of equation (6) are unobservable.

Also in the case of health, our application, Stuckler et al. (2013) report highly contested effects of aid on health, “[…] with proponents on all sides adhering strongly to their competing interpretations”. The authors find major methodological weaknesses, including failure to account for confounding extraneous factors correlated with aid, failure to account for adverse selection, issues with time lags and low power biasing towards the null hypothesis.

We propose a fourth original critique: the framework of CD and its extensions fail to explicitly differentiate needs and financial capacity. Countries’ financial capacity to invest in development outcomes is not explicitly modelled, implying that richer countries with high needs (i.e. high poverty) are not made accountable for their situation. Instead, they may receive more aid if their policy environment is relatively good. The fact that needs and financial capacity are not clearly distinguished in the framework of CD is rooted in the fact that needs (i.e. poverty reduction) and financial capacity (i.e. national income growth) are perfectly multicollinear in their benchmark
framework, as the elasticity of poverty with respect to income $\alpha_i$ is assumed to be constant across countries and equal to 2. Also for our case study, development assistance for health, needs (i.e. health outcomes) and financial means can – and should – be distinguished.

As show in this literature review, the research extending CD’s pioneering work mostly focused on the first two critiques. But making the objective function (equation 1) and the growth equation (equations 2 and 6) more complex comes at a cost: the extended frameworks are even more complex to estimate. While progressing on the first two critiques, the extended frameworks have disregarded the third critique. For example, the operationalization of the framework of Cogneau and Naudet (2007) not only requires the estimation of income elasticities $\alpha_i$ in each country and of a growth equation, as for the CD approach, but also requires the estimation of growth prospects without aid, and the estimation of the policy effort function, which depends on “pure effort”, initial poverty and circumstances. The framework of Wood (2008) further requires estimating the impact of current aid on future poverty decline. By considering a more general growth equation, Guillaumont et al. (forthcoming) multiply the number constraints on the functional form as well as the number of parameters that should be estimated.

Hence, we believe that a fundamental rethinking of the common approach is needed to respond to the four critiques altogether. It is most likely impossible to define a single objective function summarizing the multidimensionality of aid objectives. Moreover, the principle of country ownership4 further imposes limits on donors’ priorities. It would also be illusory to think that more rigorous econometrics could lead to a precise estimation of the objective function, and present a basis for development policy and aid allocation.

In response, we propose to reverse the process followed by CD-type frameworks. Instead of building an elegant but complex theoretical framework, and then struggling to estimate its parameters, we first determine what parameters can be credibly estimated (Section 3); we then determine key properties, or axioms, that should be satisfied (Section 4); and finally we build the allocation framework upon these elements (Section 5).

**SECTION 3. WHAT CAN BE ESTIMATED?**

In this section, we propose three important elements that can be estimated with reasonable precision: (1) a frontier distinguishing “effective” and “ineffective” countries

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4The principle of country ownership was endorsed by the international community at the 2005 the Paris Declaration, and then in 2008, the Accra Agenda for Action. The Paris Declaration on Aid Effectiveness (2005) proposes the following definition of country ownership: “Partner countries exercise effective leadership over their development policies, and strategies and co-ordinate development actions.”
– these terms being defined below; (2) the budget needed by “effective” countries to reach the desired development objective; and (3) the share of their budget that “effective” countries can be expected to allocate to the desired development objective.

We argue that the existence of a “development frontier” characterizing “effective countries” based on equation (6) is the first element can be estimated with reasonable precision, provided that the number of countries is sufficiently large.\(^5\) We start by noting that aid \(a_{it}\) is also the outcome of an unknown allocation process which depends on effort, circumstances and income:

\[
a_{it} = a(y_{it}, e_{it}^0, e_{it}^U, c_{it}^0, c_{it}^U)
\]

Equations (6) and (7) can hence be combined to obtain the following reduced form equation:

\[
d_{it+1} = r(y_{it}, e_{it}^0, e_{it}^U, c_{it}^0, c_{it}^U)
\]

We call “effective” the countries that have the highest level of outcome \(d_{it+1}\) for their given financial capacity \(y_{it}\). Effective countries have the most favorable circumstances and display the highest level of effort for given financial capacity \(Y_t\). While a full characterization of the function \(r\) using econometrics is impossible, we argue that “effective” countries can be identified using efficiency frontier analysis. The idea is not to measure a causal relationship, but rather to identify a function characterizing this specific group of countries. We denote this function \(e\): \(d_{it+1} = f(y_{it})\).

The estimation of the efficiency frontier can be illustrated in the context of development assistance for health. As outcome variable, we use the disability-adjusted life years (DALYs) lost to communicable, maternal, perinatal and nutritional conditions per 100,000 people\(^6\). DALYs are a standardized metric that allow for direct comparison of burdens of different diseases across countries and over time. Data is available for all countries for 2000 and 2012. Conceptually, one DALY lost is the equivalent of losing one year in good health because of either premature mortality or disability (Murray et al., 2015). Assessing health outcomes by both mortality and morbidity provides a more encompassing view on health outcomes than only looking at mortality or life expectancy alone. We measure the domestic capacity of countries using gross national income (GNI) per capita expressed in 2011 international $ (int-$) sourced from the World Bank (Anand and Bärnighausen, 2004). Sterck et al. (2016) show that the relationship

\(^5\) If the number of countries is sufficiently large, the distribution of countries in the space \((y_{it}, e_{it}^0, e_{it}^U, c_{it}^0, c_{it}^U)\) can be approximated by a continuous density function whose frontiers can be identified.

\(^6\) Three categories of health conditions are distinguished: (1) Group I DALYs lost due to communicable, maternal, perinatal and nutritional conditions; (2) DALYs lost due to non-communicable diseases; and (3) DALYs lost due to injuries. Our analysis focuses on Group I DALYs. This part of the burden of disease is the most important in our context as only 1.5% of all DAH is directed towards DALYs lost to non-communicable diseases (Dieleman et al., 2015). Moreover, since Group I DALYs can be effectively contained with a well-functioning health system, they are much stronger correlated to log GNI per capita (Sterck et al., 2016).
between GNI per capita and DALYs lost due to the disease burden of Group I is best captured by a log-log function.

Our efficiency analysis is based on quantile regression to limit the influence of outlying observations (Liu et al., 2008). Figure 1 shows the quantile regression line based on the first quartile between Group I DALYs (log) on GNI per capita (log). The slope of the regression line is negative and close to -1. Regressions results are presented in Table 1. This table shows that regression coefficients associated with GNI per capita (log) are very precisely estimated, with t-statistics ranging between 13.7 and 19.0 in absolute value. As data is available for the years 2000 and 2012, we can test whether the relationship between Group I DALYs (log) and GNI per capita (log) is stable over time. We find a very comparable coefficient when we use data for 2012 (Column 1) or 2000 (Column 2). From pooling the years we can see that neither the intercept nor the slope of the regression line changed significantly over time (Column 3).

Figure 1 – The health development frontier.

We chose to run quartile regression based on the 25th percentile. The method can be easily applied with other percentiles or using Data Envelopment Analysis.
We call this quartile regression line the “health development frontier” (HDF). Importantly, the HDF does not capture a causal relationship between health outcome and financial capacity. The HDF characterizes the level of health outcomes that can be achieved by countries displaying favorable circumstances and good level of effort, given their financial capacity. Countries on, or below, the HDF are categorized as “effective”. Countries that are above the HDF are “ineffective”, and are either penalized by unfavorable circumstances or do not display high level of effort (or both). This analysis cannot – and does not seek to – distinguish which of the two explanations explicates deviations from the frontier.

Table 1 – Quartile regressions between Group I DALYs lost per 100,000 (in log) and GNI per capita (in log)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: DALYs-C lost per 100,000 (log)</td>
<td>(log)</td>
<td>(log)</td>
<td>(log)</td>
</tr>
<tr>
<td>GNI per capita (log)</td>
<td>-0.931***</td>
<td>-0.988***</td>
<td>-0.988***</td>
</tr>
<tr>
<td>(0.0320)</td>
<td>(0.0721)</td>
<td>(0.0568)</td>
<td></td>
</tr>
<tr>
<td>Year = 2012</td>
<td>-0.468</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.747)</td>
<td>(0.0821)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td>0.0487</td>
<td>0.0487</td>
<td>0.0487</td>
</tr>
<tr>
<td>(0.295)</td>
<td>(0.644)</td>
<td>(0.507)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>16.82***</td>
<td>17.35***</td>
<td>17.35***</td>
</tr>
<tr>
<td>(0.295)</td>
<td>(0.644)</td>
<td>(0.507)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>140</td>
<td>119</td>
<td>238</td>
</tr>
</tbody>
</table>

The second element which can be estimated with relative precision is the budget needed by “effective” countries to invest in the desired development objective. By this are meant accounting estimates of providing particular public services, be it (primary) education, basic poverty relief, or in our application, basic healthcare. There is a large literature on needs and cost estimates associated with different development objectives. These works provide reasonable estimates of the cost of reaching an objective provided that money is used efficiently. For instance, total financing needs to meet basic education (including universal primary education) have been estimated by UNESCO (2007), and further calculations exist for the broader range of Education For All (EFA) objectives, as established in Dakar in 2000 (GCE, 2008). Important for our objective, these estimates do not assume or are not based on elasticities of how much particular programs contribute to reaching a development objective. Thus, they are intrinsically
different from the estimated coefficient of a growth regression.

In the case of healthcare, Article 25 of the 1948 Universal Declaration of Human Rights declares that "[e]veryone has the right to a standard of living adequate for the health and well-being of himself and of his family [...]", which includes medical care in the event of sickness and disability, where "[m]otherhood and childhood are entitled to special care and assistance" (see also Sachs, 2012). The Taskforce on Innovative International Financing for Health Systems (2009) has provided an estimate of the costs of providing basic health goods and services. These services include among others the cost of treating AIDS, TB, and malaria, immunizations, treatment of acute respiratory infections, diarrheal diseases, maternal and perinatal conditions, and malnutrition (for the entire list see Appendix 1 of the publication by the Taskforce). These costs are calculated as an average across 49 low-income countries for the year 2005. Adjusted for price differences across countries and over time, we calculate $C$, the cost of the minimum health bundle in 2012, which amounts to 198.7 int-$ per person per year (see Appendix 1). We denote $C$ as the budget needed in an effective country to move toward the realisation of the objective $d$. We do not claim that with this amount, countries automatically have the lowest level of $d$. It can take time for recurrent investments to materialize.

As the third element, we propose that the financial effort that "effective" countries can be expected to allocate to the program in order to reach the desired development objective can be estimated. The financial effort of a government, denoted $h_{it}$, is measured by the government expenditures on the relevant program, be it education, poverty relief or social expenditures, or health, as a share of GDP. The indicator of financial effort has two key advantages compared to other existing policy indicators, such as the Country Policy and Institutional Assessment (CPIA), the Worldwide Governance Indicators (WGI) or the corruption perception index (CPI). First, government spending can be distinguished by program, depending on the objectives of the donor. Government prioritization of specific sectors can therefore be taken into account when allocating aid. Second, the indicator of financial effort is a continuous variable whose changes can be instantaneously reflected in the data. Using this indicator minimize the risk of path dependency and poverty trap.

We set a target $h^*$ for the financial effort. There are international norms about budget allocation. For education, for example, the UNESCO (2014) has argued that countries should commit to spending 6% of their GNP or 20% of their government expenditures on education, of which 50% on primary education. For our case of health, we follow McIntyre and Meheus (2014) who state that governments should spend 5% of GNI on health goods and services. Also the World Health Report 2010 notes that "[...] those countries whose entire populations have access to a set of services usually have relatively high levels of [mandatory] pooled funds – in the order of 5-6% of gross domestic product" (WHO, 2010).
SECTION 4. AXIOMS FOR THE ALLOCATION OF AID

Building on the three measurable quantities defined in Section 3, this section defines axioms for the allocation of aid. We formalize the axioms considering two hypothetical countries $i$ and $j$. The axioms are then combined into an allocation formula in Section 5. The first two columns of Table 2 summarize the variables that are used in this section.

Following our critique on the CD framework, we explicitly distinguish between needs and financial capacity using Axioms (i) and (ii). These axioms can be justified on the basis of fairness. Aid should be provided with a particular development objective in mind. Therefore, aid per capita should depend on the needs of countries in terms of these objectives. On the other hand, countries with more available financial means, other things being equal, can and should be held more accountable for their development outcomes, implying that they should not receive more aid per capita.

Axiom (i) on needs: everything else being equal, countries with strictly higher needs should not receive less aid per capita.

\[ y_{it} = y_{jt}, \ h_{it} = h_{jt} \ \text{and} \ d_{it} > d_{jt} \ \Rightarrow \ a_{it} \geq a_{jt} \quad (9) \]

Axiom (ii) on financial capacity: everything else being equal, countries with strictly higher domestic capacity should not receive more aid per capita.

\[ d_{it} = d_{jt}, \ h_{it} = h_{jt} \ \text{and} \ y_{it} < y_{jt} \ \Rightarrow \ a_{it} \geq a_{jt} \quad (10) \]

Axioms (i) and (ii) address the distribution of aid between countries, but do not provide information about the level of aid that countries should receive. Given a budget needed to deliver a certain development objective, donors should complement government expenditures in order to allow countries to reach this budget, as long as countries are effective and exert the desired level of financial effort themselves. The requirement of a desired level of budget allocated to delivering the objective domestically puts a (measurable) obligation and incentive on the receiving country.

Axiom (iii) on the level of aid for effective countries: for effective countries displaying the desired level of domestic financial effort $h_{it} = h^*$, aid should top up government expenditure to fund the costs of necessary investments in the development objective $c$:

\[ a_{it} = \max(c - g_{it}, 0) = \max(c - h^* y_{it}, 0) \quad (11) \]

Given the objective of aid to improve certain development outcomes, the allocation of it should not crowd out domestic funding (see e.g., Morrissey, 2015; Prichard, 2016). Rather, the formula should encourage domestic contributions.
**Axiom (iv) on domestic financing:** the allocation formula should encourage domestic contribution of recipient countries targeted at the objective.

Here, we opt for the wording “encourage” instead of “maximize” on purpose. Designing aid allocation to maximize the domestic contribution of a country would require knowing how government expenditure targeted at the objective varies as a function of the allocation formula (e.g., Svensson, 2000; 2003). This reaction function is unknown, as it depends on the unknown objective function and budget constraints of the government. While maximizing domestic contribution in the strict sense seems therefore infeasible, we aim to design an allocation formula that encourages domestic contribution.

To encourage domestic funding, the amount of aid allocated should increase with government expenditure targeted at the objective \( \frac{\partial a_{it}}{\partial h_{it}} > 0 \). In other words, the allocation formula should be defined as a counterpart financing rule, which we denote \( \delta_{it} \). We define \( \delta_{it} \) as the share of government health expenditures relative to total health expenditure, with \( 0 \leq \delta_{it} \leq 1 \):

\[
\delta_{it} \equiv \frac{g_{it}}{g_{it} + a_{it}}
\]  
(12)

Denoting \( h_{it} \) as the ratio \( \frac{g_{it}}{y_{it}} \), we can rewrite equation (5) as follows:

\[
\delta_{it} \equiv \frac{h_{it}y_{it}}{h_{it}y_{it} + a_{it}}
\]  
(13)

Given needs and financial effort, the relationship between counterpart financing \( \delta_{it} \) and national income \( y_{it} \) is given by:

\[
\frac{\partial \delta_{it}}{\partial y_{it}} = \frac{h_{it} (a_{it} - \frac{\partial a_{it}}{\partial y_{it}} y_{it})}{(h_{it} y_{it} + a_{it})^2} \geq 0 \text{ as } a_{it} < 0 \text{ following Axiom (ii)}
\]  
(14)

This derivative is strictly positive for countries receiving aid (as \( a_{it} > 0 \Rightarrow h_{it} > 0 \)). Following equation (14), we have that counterpart financing is higher when \( y_{it} \) is larger, for given financial effort and needs. In other words, a dollar of aid will lead to more domestic expenditure if this dollar is given to a richer country. Thus, if donors want to encourage domestic expenditure for given financial effort and needs, they should allocate aid to the richest of two countries with the same levels of needs and financial effort.

\[
d_{it} = d_{jt}, \ h_{it} = h_{jt} \text{ and } y_{it} < y_{jt} \Rightarrow a_{it} \leq a_{jt}
\]  
(15)

The last axiom pertains to countries not complying with the desired level of financial effort \( (h_{it} \neq h^*) \).

**Axiom (v) on proportionality:** the elasticity of aid with respect to financial effort is equal to 1.

\[
\frac{\partial a_{it}/a_{it}}{\partial h_{it}/h_{it}} = 1
\]  
(16)
Axiom (v) implies that aid should be proportional to domestic financial effort: a doubling of domestic financial effort should double the amount of aid.

This axiom is grounded in the recognition that the priorities of government may not be exactly aligned with those of the international community. The principle of country ownership, acknowledged in both the Paris Declaration on Aid Effectiveness (2005) and the Accra Agenda for Action (2008), affirms that receiving countries should have sufficient autonomy to set their development priorities and define their own strategies (see e.g. Bigsten and Tengstam, 2015).

To foster the desired level of investment in the development objective ($h_{lt} = h^*$), an extreme allocation rule would consist in a lump-sum transfer equal to $\max(c - h_{lt}^y y_{lt}, 0)$ for countries satisfying $h_{lt} = h^*$, while aid would be equal to zero if $h_{lt} < h^*$. This allocation would satisfy Axiom (i) to (iii) while minimizing total aid. Axiom (v) argues that the “sanction” of not complying with the objective $h_{lt} = h^*$ should not be as dramatic. Countries should have the discretionary space to not fully comply with the objective $h_{lt} = h^*$, for example when dealing with shocks or having other priorities. It seems unreasonable and unfair to force them to comply with the objective $h_{lt} = h^*$ through a conditional lump-sum transfer. Such an allocation would potentially lead to volatile and procyclical allocation of DAH. Axiom (v) postulates that the “sanction” for “non-compliance” should rather be proportional to the exerted domestic financial effort.

The counterpart financing rule of the U.S. President’s Emergency Plan for AIDS Relief (PEPFAR) and of the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) also respect the proportionality axiom.

---

8 Country ownership allows receiving countries to decide on the national strategies that fit with their knowledge of local contexts and needs (Bourguignon and Sundberg, 2007; Bourguignon and Platteau, 2015; forthcoming). As governments are responsible for their own strategies, citizens can hold their government accountable, incentivizing the government to be responsive to local needs (Deaton, 2013).

9 In other words, the counterpart financing rule $\delta_{lt}(h_{lt})$ would be non-continuous and equal to 0 everywhere except in $h_{lt} = h^*$.

10 This axiom is hence aligned with the principle of proportionality in law. This principle is usually applied on grounds of fairness. It entails that an imposed sanction should stand in relation to the severity of the illicit act (see e.g. Shavell, 2009).

11 PEPFAR requires counterpart financing of 25% by governments (Vassall et al., 2013). The GFATM defines counterpart financing thresholds as a function of country’s income classification. The minimum threshold is 5 percent for LICs, 20 percent for Lower LMICs, 40 percent for Upper LMICs, and 60 percent for UMICs.
Table 2 – Definition of variables and operationalization

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Operationalization (for allocation of DAH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_{it}$</td>
<td>Level of aid per capita</td>
<td>Development assistance for health per capita, in int-$ (DAH_{it})$</td>
</tr>
<tr>
<td>$y_{it}$</td>
<td>National income per capita (corrected for price differences)</td>
<td>Gross national income per capita, in int-$ (GNI_{it})$</td>
</tr>
<tr>
<td>$d_{it}$</td>
<td>The development objective</td>
<td>Burden of disease as measured by Group I DALYs lost per 100,000 ($DALY_{it}$)</td>
</tr>
<tr>
<td>$g_{it}$</td>
<td>Government expenditures per capita allocated to the development objective</td>
<td>Government health expenditures ($GHE_{it}$) in int-$</td>
</tr>
<tr>
<td>$h_{it}$</td>
<td>Share of GNI allocated by the government to the development objective ($g_{it}/y_{it}$)</td>
<td>Share of government health expenditures in GNI ($GHE_{it}/GNI_{it}$)</td>
</tr>
<tr>
<td>$\delta_{it}$</td>
<td>Counterpart financing: share expenditures allocated to the development objective paid domestically ($g_{it}/GHE_{it}+DAH_{it}$)</td>
<td>Share of total health expenditures paid domestically</td>
</tr>
<tr>
<td>$d_{it+1} = f(y_{it})$</td>
<td>Development frontier</td>
<td>$\log(DALY_{it}) = \beta_0 + \beta_1 \log(GNI_{it})$ with $\beta_0 = 16.9$ and $\beta_1 = -0.94$</td>
</tr>
<tr>
<td>$c$</td>
<td>Per capita cost of tackling the development objective</td>
<td>Per capita cost of basic healthcare (198.7 int-$)$</td>
</tr>
<tr>
<td>$h^*$</td>
<td>Desired level of domestic financial effort</td>
<td>5%</td>
</tr>
</tbody>
</table>
Equation (16) imposes a constraint on the functional form of the counterpart financing rule \( \delta_{it} \). Following equation (13), the derivative of counterpart financing \( \delta_{it} \) with respect to financial effort \( h_{it} \) is given by:

\[
\frac{\partial \delta_{it}}{\partial h_{it}} = \frac{y_{it} a_{it} - \frac{\partial a_{it}}{\partial h_{it}} h_{it} y_{it}}{(h_{it} y_{it} + a_{it})^2} = \frac{y_{it} (a_{it} - \frac{\partial a_{it}}{\partial h_{it}} h_{it})}{(h_{it} y_{it} + a_{it})^2} \tag{17}
\]

Taken together, equations (16) and (17) imply the following equality:

\[
\frac{\partial \delta_{it}}{\partial h_{it}} = 0 \tag{18}
\]

Two remarks should be made before deriving the allocation formula from these axioms. First, by no means we claim that our list of axioms is definitive. While axioms (i) and (ii) are very intuitive and probably unavoidable, axioms (iii) to (v) could be subject to revision, for example, if more data becomes available on the preferences and the reactions functions of governments and donors.

Second, we purposely did not define a budget constraint, i.e. a limit to the total amount of aid that the international community is ready to pay for the development objective. This choice is justified by our ambition to study how much aid is needed to fulfil the development objective, as well as how this aid should be allocated. Another starting point, corresponding to a different research question, would be to exogenously define a budget constraint and determine how this aid budget should be distributed. In this case, either the parameters \( c \) or \( h^* \), or axioms (iii) to (v) would have to be revised. Such adaptation is a good topic for future research.

**SECTION 5. ALLOCATION FORMULA**

We build on what is observable (Section 3) and on axioms (Section 4) to derive the allocation formula.

**FOR EFFECTIVE COUNTRIES**

From Axiom (ii) we have:

\[
a_{it} = \frac{1 - \delta_{it}}{\delta_{it}} g_{it} = \frac{1 - \delta_{it}}{\delta_{it}} h_{it} y_{it} \leftrightarrow \delta_{it} = \frac{h_{it} y_{it}}{a_{it} + h_{it} y_{it}} \tag{19}
\]

From Axiom (iii), we have for effective countries putting financial effort \( h^*_{it} \) in the development objective:

\[
\delta_{it} = \max \left( \frac{h^* y_{it}}{c}, 0 \right)
\]

Because \( 0 \leq \delta_{it} \leq 1 \), we have:

\[
\delta_{it} = \min \left( \max \left( \frac{h^* y_{it}}{c}, 0 \right), 1 \right) \tag{20}
\]
Because of equation (18), we have that equation (20) also defines the counterpart financing rule for effective countries characterized by a different level of financial effort than $h^*$. Equation (20) shows that counterpart financing ratio for effective countries is a linear function of a country’s financial capacity, which depends on national income, $y_{it}$, and on the share of national income that is expected to be allocated to the development objective, $h_{it}$. The counterpart financing ratio is an inverse function of the expected per capita cost of financing the development objective in effective countries, $c$.

**FOR INEFFECTIVE COUNTRIES**

To facilitate reasoning, we abstract from time and compare the level of DAH that should be allocated to two fictive countries E and I. For each “ineffective” country I above the development frontier we compare it to a hypothetical “effective” country E which has the same initial level of development ($d_E = d_I$) and the same percentage of domestic expenditure on the development objective ($h_E = h_I = h^*$), but country E is on the development frontier ($d_E = f(y_E)$). Thus, country I is richer but ineffective compared to country E.

Together, equations (10) and (15) imply that countries with similar disease burden and similar government health expenditures should receive similar amount of DAH per capita:

$$d_E = d_I, \ h_E = h_I \ \text{and} \ y_E < y_I \ \Rightarrow \ a_E = a_I \quad (21)$$

Since country E is effective (i.e., on the development frontier), its level of aid per capita is given by equation (19). Equation (19) can be rewritten by imputing the function of the development frontier:

$$a_E = \max(c - h_E f^{-1}(y_E), 0) \quad (22)$$

Countries E and I have the same level of development and the same percentage of government expenditure on the development objective. Equations (13), (18) and (22) can therefore be combined to obtain the amount of aid that country I should be entitled:

$$a_E = a_I \ \iff \ \max(c - h_E f^{-1}(y_E), 0) = \frac{1 - \delta_I}{\delta_I} h_I y_I$$

$$\iff \ \frac{1 - \delta_I}{\delta_I} = \frac{1}{y_I} \max\left(\frac{c}{y_I} - f(d_E), 0\right)$$

$$\iff \ \delta_I = \max\left(\frac{y_I}{y_I + \frac{c}{y_I} - f(d_I)}, 0\right)$$

Because $0 \leq \delta_{it} \leq 1$, we have:

$$\delta_I = \min\left(\max\left(\frac{y_I}{y_I + \frac{c}{y_I} - f(d_I)}, 0\right), 1\right) \quad (23)$$

This last equation gives the counterpart financing rule for any country which is not effective, as a function of its national income $y_I$ and its development level $d_I$. 

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SECTION 6. APPLICATION TO DEVELOPMENT ASSISTANCE FOR HEALTH

In this section we apply the framework to the allocation of DAH between countries. The third column in Table 2 lists how each variable of the general framework is operationalized for the allocation of DAH.

The counterpart financing rule for an effective country is a function of its national income \( y_{it} \) and of parameters \( c \) and \( h^* \) (equation (20)). National income is measured by GNI per capita (Anand and Bärnighausen, 2004). The per capita costs of providing basic health care in effective countries \( c \) and the share of national income that is expected to be allocated to the development objective \( h^* \) were determined in Section 3 \((c = 198.7 \text{ int-$}, \ h^* = 0.05)\). The counterpart financing rule for effective countries is therefore given by:

\[
\delta_E = \min \left( \max \left( \frac{0.05 y_{it}}{198.7 \text{ int-$}} , 0 \right), 1 \right) = \min \left( \max \left( \frac{y_{it}}{3,974 \text{ int-$}} , 0 \right), 1 \right)
\]  

(24)

We have \( \delta_E = 1 \) when the ratio \( \frac{c}{h^*} = \frac{198.7 \text{ int-$}}{0.05} = 3,974 \text{ int-$} \). This ratio therefore defines the GNI per capita threshold above which an effective country is deemed to possess sufficient domestic resources to fund basic health care domestically.

For ineffective countries, the allocation framework additionally accounts for the development needs of each country (equation (23)), as measured by Group I DALYs per capita. Using the parameters of the development frontier derived in Section 3 and substituting \( c \) with the costs of basic healthcare and \( h^* \) with the expected domestic contribution yields:

\[
\delta_I = \min \left( \max \left( \frac{y_I}{y_I+3,974 \text{ int-$} e^{(\log(DALY_I)-16.9)/0.94}} , 0 \right), 1 \right)
\]  

(25)

We apply these formulas for the 140 countries for which GNI per capita and Group I DALYs data are available. The map in Figure 2 shows the counterpart financing rule \( \delta_{it} \) (all countries with \( \delta_{it} < 1 \) are shown). The resulting counterpart financing rule is also visualized in Figure 3, as a function of GNI per capita and Group I DALYs lost.

By construction, all axioms defined in Section 4 are satisfied. Here we provide intuition, making use of Figure 3. For ineffective countries, counterpart financing increases for any downward move on Figure 3, in line with Axiom (i) on needs. For effective countries, it is interesting to note that counterpart financing does not vary with their burden of disease, but is a linear function of their financial capacity. Intuitively, countries that are more efficient than the HDF are not penalized for their high effectiveness. In line with Axiom (ii), counterpart financing requirements decrease for every move to the right in Figure 3. While Axiom (iii) determines the counterpart financing rule on and below the HDF (for
effective countries), Axiom (iv) determines the slope of the contour lines. Axiom (v), on proportionality, cannot be visualized in Figure 3. It determines how aid varies with the level of financial effort. This latter axiom is discussed below when exploring country examples.

Figure 2 – Counterpart financing: Share of the domestic contribution ($\delta_{it}$) to public spending on health according to the allocation framework. Shown is the world region with all countries for which $\delta_{it} < 100\%$.

Based on the counterpart financing ratios, we calculate the total amount of DAH to be allocated across countries. Following axioms (iv) and (v), the amount of DAH a country receives depends on the reaction of its government to the new framework. We consider three different scenarios.

In the business-as-usual scenario (BAU), countries do not increase domestic contributions in reaction to the new framework. Under this scenario, the total amount of DAH is estimated at 36.7 billion US-

In the exact-cost scenario (EC), we assume that countries choose the level of government health expenditures (GHE) to be able to exactly finance universal primary healthcare with the help of DAH. The sum of GHE per capita and DAH per capita is set to be equal to the estimated cost of universal primary healthcare, that is, 77.5 US-$ or 198.7 int-$ per capita for all countries. The total amount of DAH under this scenario is estimated at 76.3 billion US-$.

\[12\] The indicator of government health expenditures per capita (GHE per capita provided by the WHO) used to produce these estimates partly includes development assistance for health (DAH). These estimates are therefore upper-bound estimates of the cost of the business-as-usual scenario.
In the optimistic scenario (5P), we assume that countries increase government health expenditures to 5% of GNI per capita. Under this scenario, the total amount of DAH is 111.2 billion US.

In comparison, aggregate DAH was equal to 32.1 billion US-$ in 2012.\textsuperscript{13} Sachs (2012) estimated that 40 billion US-$ per year would be needed from the donor world to achieve universal health coverage in low-income settings. Ottersen et al. (2014) estimated that the total need for DAH ranges between 79 to 436 billion US-$ billion depending on different scenarios.

\textbf{Figure 3 – Counterpart financing rule in the allocation of development assistance for health (DAH). The shaded areas show the share of domestic contribution of total health expenditure.}

\textsuperscript{13}From this amount, only 8.3 billion US-$ was channeled to governments, while the rest was allocated to non-governmental organizations.
Figure 4 – The current allocation of DAH, and the amount of DAH and government spending on health under three different scenarios.

Figure 4 compares the current government expenditures and development assistance on health to the allocation of DAH under different scenarios. To illustrate the allocation rule, we consider the following five country cases, all of which are highlighted in Figure 3: Malawi, Rwanda, China, Kenya, and South Africa.

Malawi, Rwanda, and China were chosen because they are very close to the HDF, but have very different GNI per capita. Malawi is an effective country, but it is poor ($y = 726$ int-$.). According to the counterpart financing rule $\delta_E$, Malawi should finance $726$ int-$/$3,974 int-$ = 18.2%$ domestically. In the 5%-scenario Malawi is spending 5% of its GNI on government health expenditures, or 726*
5% = 36.3 int-$ per capita, it will be entitled to 162.4 int-$ DAH per capita, or 100.6 US-$. From Axiom (v) it follows that DAH is proportional to $h_i$. Thus, if Malawi were to spend only 2.5% of its GNI on government health expenditures, it would receive half of the 162.4 int-$ DAH per capita or 50.3 US-$. 

Rwanda is effective, but it has a higher GNI per capita (1,463 int-$) than Malawi. According to the counterpart financing rule for effective countries, Rwanda should domestically finance 1,463 int-$/3,974 int-$ = 36.8% of total health expenditures. If Rwanda spends 5% of its GNI on government health expenditures, it will be entitled to 125.6 int-$ or 54.9 US-$ DAH per capita. 

Finally, China is also below the HDF but it is much richer than Malawi and Rwanda. As China’s GNI per capita (10,040 int-) is above the minimum GNI per capita of finance basic healthcare, it will contribute 100% domestically to its health expenditures in the long run regime. 

Kenya and South Africa were selected as examples because both countries suffer from high disease burden (34,731 and 34,994 per 100,000 respectively), but Kenya is much poorer than South Africa. The allocation formula for ineffective countries yields that the domestic counterpart financing is equal to 46.7% for Kenya and 79.8% for South Africa. If both countries invest 5% of their GNI per capita in government expenditure for health, both countries will receive about 152 int-$ per capita of DAH (62.2 and 96.6 US-$ for Kenya and South Africa respectively). As before, DAH is proportional to the government health expenditures as a percentage of GNI. 

A number of conclusions can be drawn from comparing our allocation results to the current one. First, aid is given to fewer countries in our framework than currently is the practice. According to our allocation framework there are 51 countries that would receive DAH. This is contrasted with 84 countries which according to the IHME received DAH in 2012. 

Second, our framework tends to be more generous than the current allocation of DAH. Of the countries which will receive DAH according to our framework, only Laos and Timor are currently characterized by a lower share of domestic financing than their counterpart financing ratio ($\frac{GHE_{it}}{THE_{it}} < \delta_{it}$). For 27 countries, the counterpart financing ratio $\delta_{it}$ is lower than 50%, while only 3 countries currently have their share of government expenditures in total health expenditures, $\frac{GHE_{it}}{THE_{it}}$, below 50% (Mozambique, Laos and Burundi). 

Finally, the new framework incentivizes domestic funding in absolute amounts. As can be seen from Figure 4, health expenditures in absolute terms increase under the EC and 5P scenarios.
SECTION 7. DISCUSSION AND CONCLUSION

Academic endeavours to derive an allocation formula have been dominated by a paradigm introduced in the seminal work of CD (2001; 2002). This paradigm consists in defining an objective function, conducting a growth regression to estimate parameters, and an ex-post assessment whether face validity is achieved. Multiple authors have extended and nuanced the original objective function and growth equation, criticizing the original equations for being incomplete or unfair. Another recurring point of criticism has been the fundamental econometric problems underlying the growth regression. Although widely expressed as a severe hindrance, this empirical critique has not been taken on board in the allocation formula literature, ironically even though CD (2001) end their paper stressing: “Please do not take the point estimates too seriously”. To these critiques we add that existing allocation formulas do not distinguish needs from domestic capacity of recipient countries.

In this paper, we constructed an allocation framework in a fundamentally different fashion. We first determined what parameters can be credibly estimated and what key properties, or axioms, a fair allocation framework should satisfy. With these building blocks we derived an allocation formula taking the form of a counterpart financing rule, which we then applied to development assistance for healthcare. The total amount of DAH to be allocated among countries based on our formula ranges between 37 and 111 billion US-$, depending on how countries respond to the framework.

Our approach is not demanding in terms of data and operationalization, which is a key advantage for its application. In particular, it does not rely on the estimation of a growth equation. The single estimation to be conducted is the derivation of the development frontier between national income and the development objective. The only required indicators are national income per capita, the development objective, and the share of income allocated by the government to the development objective. Necessary estimates of per capita cost of delivering a development objective and the desired level of domestic financial efforts by the government can be taken from existing studies and can easily be refined when new data is available.

The new approach also has the advantage of being explicit and theoretically grounded, making the allocation framework easily implementable and replicable. In our selection of axioms, the distinction between needs and domestic capacity plays a pivotal role, and the formula is defined as a proportional counterpart financing rule to boost domestic financing. However, given the wide variety of normative viewpoints – not in the last place by donors, who ultimately are the implementers of allocation formulas – the framework can easily be adapted. Our allocation formula is not based on discrete income threshold as is often the case
in current allocation formulas of donor organizations, to reduce the risk that
countries face a fiscal cliff with multiple donor withdrawal when graduating
from one income category to another (Saxenian et al., 2015; Sumner, 2011). This
risk is particularly worrying for health systems, as positive health outcomes can
be reversed when investment in health are stopped, even if only for a short
period (Piot et al., 2015).

In this paper we look at development assistance for health. Our framework can
be applied to other development objectives, such as poverty relief or education,
as long as estimates of per capita costs of delivering the development objective
and the desired level of domestic financial efforts by the government are
available. Our list of axioms is by no means definitive, and the framework can be
further refined, for instance by introducing dynamics such as in Wood (2008), by
incorporating a budget constraint, or by studying how countries can move from
inefficiency to efficiency as defined in our framework. In our current formula the
amount of aid a country receives depends on its financial efforts. Future research
could also consider how inclusive these financial efforts are.
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APPENDIX 1. PER CAPITA COSTS OF BASIC HEALTHCARE

The Taskforce on Innovative International Financing for Health Systems (2009) calculated a price for a minimum bundle of health goods and services of 54 US-$. This is an average over 49 poor countries and this consumption bundle has a non-traded part (62%) and a traded part (the remaining 38%).

We convert this into 2012 US-$ by taking the inflation in the U.S. into account to adjust for price changes of the imported goods and by separately taking inflation in the 49 poor countries into account to adjust for the price changes of the domestically purchased part of the health bundle.

We take the price change in the 49 poor countries from Meheus and McIntyre (2014) who report a 59% price increase between 2005 and 2012. We take the price change in the U.S. from the OECD which report an 18% price increase (CPI) between 2005 and 2012.

\[
(54 \text{ US$} \times 0.38) \times (1 + 0.18) + (54 \text{ US$} \times 0.62) \times (1 + 0.59) = 77.45 \text{ US$ (in 2012 prices)}
\]

We then calculate the population weighted average price level ratio of the PPP conversion factor (GDP) to market exchange rate for the benchmark year of the latest ICP, which was 2011. The data for this are taken from the World Bank’s World Development Indicators. For the 49 countries this ratio relative to the US is 0.39.

\[
\frac{77.45 \text{ US$}}{0.39} = 198.73 \text{ international $}
\]

We use this as the per capita costs of basic healthcare in int-$ in 2012.

Data used:

- The "High Level Taskforce for Innovative International Financing of Health Systems" (http://bit.ly/1SIDN3f) calculated a price for a minimum bundle of health goods and services of 54 US-$. This is an average over 49 poor countries.
- For 2011 the population weighted “Price level ratio of PPP conversion factor (GDP) to market exchange rate” is .38970678 (rounded to 0.39)