FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

Working Paper 60
December 2012
Development Policies

Getting Progress Right : Measuring Progress Towards the MDGs Against Historical Trends

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Abstract

Most numerical targets within the framework of the Millennium Development Goals (MDGs) are overly ambitious for the poorest countries when interpreted as country-specic goals. As a consequence, the current system undermines accountability and ownership and jeopardizes the public support the MDGs have drawn in the past. This paper proposes an alternative approach to evaluating progress towards non-income MDGs that allows a sensible appraisal of countries' performance ... /...

JEL: I15, I18, I25, I28, I32 .
Keywords: millennium development goals; human development; mortality transition; education transition.

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… / … We first estimate transition paths towards high levels of achievement for under-five mortality, the leading indicator of MDG4. In line with previous empirical work, we find that the sigmoid-shaped transition path captures several features of past transition episodes, in particular, relative rates of change in the indicator. We also provide a comparison between progress in today's developing countries to the experience of today's industrialized countries during the 19th and 20th century. Accounting only for initial levels and time elapsed, our models explain a large share of the within-country variation in the data. Estimated transition paths are then used to project progress towards high levels of achievement over the 1990-2010 period. Comparing actual with projected progress allows us to identify over- and underachievers based on realistic expectations. For example, we find that while some countries in Sub-Sahara Africa have in fact shown considerable performance towards low levels of under-five mortality, the bulk of the countries in that region is still lagging behind. We then discuss the applicability of our method to other MDG indicators, in particular low height-for-age in children (MDG1C), completion of primary education (MDG2), and the gender ratio in education (MDG3). Finally, we analyze the likely determinants of progress towards low levels of under-five mortality in regressions.

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JEL Classification Numbers: I15, I18, I25, I28, I32 .

Contents

1 Introduction

The Millennium Development Goals (MDGs) supply policymakers and their constituencies with quantifiable targets, most of which are to be achieved by 2015. For example, the MDGs demand the attainment of universal primary education (MDG2) and the reduction in under-five mortality by two-thirds relative to its level in 1990 (MDG4). Accordingly, the UN frequently assesses whether a country is on-track or off-track to meet these goals by comparing observed rates of progress to rates required to meet the targets.

Several recent contributions have argued that this has led to a perverse situation in which the least developed countries are doomed to fail no matter how their performance compares to their peers' or to past experience [Clemens, 2004, Clemens et al., 2007, Easterly, 2009]. Most MDGs—no matter whether they are defined in terms of levels to be achieved or relative changes—become harder to attain the less developed a country.

These conceptual problems in assessing progress undermine the credibility of the MDG system and jeopardize the public support the goals have drawn in the past. Drawing up realistic targets, on the other hand, would improve the effectiveness of the MDG system. First, moving to realistic targets might prevent the public in donor countries from concluding that development aid does not deliver the goods, what is generally refered to as 'aid fatigue' [Easterly, 2009]. This is all the more a problem given that donor countries are facing increasingly severe budget constraints. Second, policymakers cannot be held responsible for not reaching targets that were not attainable in the first place. Realistic, country-specific targets would provide constituencies in developing countries with a yardstick against which their country's progress can be judged. Implementing realistic targets would thus improve accountability.

This paper addresses these shortcomings of the numerical targets as they are interpreted today. We argue that progress towards the MDGs should be judged against what has been observed in the past and taking into account countries' starting levels. To show this we first estimate transition paths for two of the leading non-income MDG indicators under MDG4, namely under-five and infant mortality rates. Our results are in line with previous empirical work, particularly in the literature on education expansion, suggesting that progress towards high levels of human development follows an s-shaped (logistic) transition path which tends to be remarkably similar across countries [Meyer et al., 1992, Clemens, 2004, Clemens et al., 2007, Lay, 2010].

Second, we analyze how one would judge progress towards MDG4 today if one takes into account past experience and the level from which each country started. Our estimates of average transition paths allow us to calculate country-specific performance indices as the ratio of actual to expected progress. We argue that it is worth considering replacing the MDGs' numerical targets with a set of country-specific, realistic goals based on past transition paths. Finally, we run explanatory regressions in order to explain differences in performance towards MDG4 over the 1990–2010 period.

Several other authors have proposed new methods to evaluate progress towards the MDGs. Leo and Barmeier [2010] compare absolute and relative changes to required changes assigning a score of unity if countries achieve the target based on linear projections and, somewhat arbitrarily, a score of one half if they achieve half of the required progress to account for different starting levels. Chakravarty and Majumder [2008] follow an axiomatic approach to derive a composite index which allows to decompose changes into percentage contributions made by different indicators. However, these authors do not question the appropriateness of the targets at the country-level.

Fukuda-Parr and Greenstein [2010] follow a different approach. They argue that faster progress in the post-MDG decade signals political commitment to the MDG framework. Thus, achievement should be judged according to whether or not progress in absolute terms has accelerated after implementation of the MDG system. Based on a pre-post comparison of annual absolute changes, they find that for the majority of indicators and countries progress has not accelerated. This finding is consistent with our empirical findings in that the logistic growth model implies that absolute changes in indicators decrease the higher the initial level (for indicators for which higher values signal a higher level of development).

Hailu and Tsukuda [2011] base a pre-post comparison on Kakwanis 1993 method.[1] While this method takes into account that further progress becomes more difficult to attain the closer a country

[1] Kakwani [1993] derives a class of achievement and improvement functions on the basis of three parameters: an upper bound, a lower bound, and a parameter that determines how the same absolute change translates into progress at different initial levels.

is to achieving a target, the parameter that deterines how much more a given absolute change is valued at higher levels is not estimated from the data but set arbitrarily by the authors.

The paper is organized as follows: in order to illustrate the problem with today's MDG targets, section 2 looks at trends in under-five mortality over the 1990–2010 period. In section 3 we develop a stylized model to explain the evolution of an s-shaped transition path which we then link to our empirical approach. In section 4 we estimate transition paths towards low levels of under-five and infant mortality. For the latter indicator, we also compare our results for the 1960–2010 period to the experience of a sample of today's industrialized countries. In section 5 we define our performance index for under-five mortality based on these estimations and compare it to the performance measure implied by the numerical target. While our focus is mainly on under-five and infant mortality, we also argue in section 6 that our approach can in principle be applied to indicators like stunting, primary completion, and gender ratios in education. However, all of these indicators have several shortcomings that make judgements of progress more difficult and estimation of transition paths less reliable. Section 7 presents some preliminary results from regression analysis. Section 8 concludes.

2 Trends in under-five mortality, 1990–2010

In the case of MDGs defined as absolute targets like universal primary education (MDG2) and gender parity in education (MDG3) it is obvious that they are more challenging for countries starting at lower levels of achievement. Recent contributions by Clemens et al. [2007], Vandemoortele [2009] and Easterly [2009] argue that this is also the case for MDGs defined in relative terms like the reduction of under-five and maternal mortality by two-thirds and three-fourths, respectively, and the reduction of the proportion of children stunted by one-half. Vandemoortele [2009], one of the co-architects of the MDG system, argues that the numerical targets were arrived at by linear extrapolation from global trends prior to 1990 over the 1990-2015 period. Thus, the MDGs were to be reached at the global level rather than at the country-level. Nevertheless, for lack of further coordination between actors as to how much each country would have to contribute in order to attain these goals, the numerical targets are usually interpreted as national policy goals. National governments, NGOs, and even UN agencies frequently interpret the specific targets at the country-level.

The argument that the relative targets are more challenging for countries starting at lower levels of achievement is illustrated by figure 1 which plots absolute and relative annual changes in the under-five mortality rate over the 1990–2010 period against inital levels in 1990.[2] The left panel shows a narrowing of the gap between countries in absolute terms, a common finding in the literature. For example, Kenny [2005] finds evidence for convergence in most quality-of-life indicators between countries. The intuition behind this is rather perspicuous: given the right policy environment, it is often possible for high-mortality countries to make rapid progress by implementing readily available, cost-effective policies that have an immediate effect on mortality. Countries at lower levels of mortality, on the other hand, need to implement more sophisticated (and more expensive) policies to further push down the mortality rate.

The right panel shows that the expected relative rate of reduction is lower in countries starting with higher inital levels. This is at the heart of the criticism of MDG4:[3] the higher a country's initial level of mortality, the less likely it is to achieve a given rate of reduction. In particular, note that there is not a single country with an inital under-five mortality level of more than 200 deaths per 1,000 that has achieved an average rate of reduction of more than 4.3 percent, the rate required to bring about a two-thirds reduction over a period of 25 years. This is not to say that it is not possible; it simply seems to be more of a challenge.

Although we discuss applying the methodology proposed to other non-income indicators in section 6, in what follows, we will focus on under-five and infant mortality. There are several reasons for us to do so: first, data coverage at the country-level from the World Development Indicators is almost exhaustive, albeit at the cost of using imputed data points in some cases.[4] Data

[2]Data for under-five mortality is provided by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA, UNDP) through the World Bank's World Development Indicators 2011 database.

[3]From a normative perspective, the absolute level of reduction in a mortality rate is probably the correct indicator [Deaton, 2006].

[4]There is a trade-off worth discussing between avoiding selection bias induced by a correlation between progress and selection into the sample and the overall quality of the data. Below, we also provide a robustness check in form of an alternative, high-quality data source on under-five mortality.

quality certainly differs between countries, but since there are now comparable household surveys on health issues including birth histories of women (e.g. the Demographic and Health Surveys (DHS)) in a large number of developing countries, we have a fairly good picture of developments in under-five and infant mortality over the last decades for a large portion of the population in the developing world. Second, reducing child mortality is a relevant target for nearly all developing countries (as opposed to, say, reversing the spread of HIV/AIDS). There is still a considerable gap between child mortality rates in rich and poor countries, with ample potential for catching-up. Third, from a normative point of view, under-five and infant mortality is one of the most attractive MDG indicators. It is without doubt an ultimate end of development to avoid premature death, as opposed to other indicators that must be seen more as means to achieving certain ends (vaccination rates fall into this category).

3 Theoretical considerations

In the recent past, some illustrative theoretical models have been proposed in the literature that demonstrate what kind of setting would result in an s-shaped transition path towards high achievements in an indicator of human development. These models are usually based on the assumption of logistically distributed incomes, direct costs, or both. Clemens [2004] bases his analysis of the education transition on a simple version of the standard Beckerian model of human development, in which parents weigh the present value of their child's consequent lifetime wage increment against the direct and indirect costs of schooling. Logistic growth comes about as a result of logistically distributed future incomes and current costs of schooling. Lay [2010] makes a similar point assuming that current incomes are logistically distributed, which, in turn, determine up-take of social services. The main intuition behind these models is that, initially, only the most well-off individuals will have access to these services. As incomes grow at a (roughly) constant rate across the income distribution, the share of households with access will increase at a faster rate. At this stage, the population share that gains access in each period will increase over time as middle- and lower middle class households gain access. After half the population is covered, the share added to those with access will start decreasing again. Finally, it becomes increasingly difficult to make further inroads as only the poorest members of society lack access.

To give a specific example of this kind of model we consider the case of child mortality. Assume that a child's probability to die before before age five depends on receiving a particular treatment. For example, this could be a vaccine or safe drinking water. To fix ideas, think of a vaccine. The child will die with probability $\overline{mr}$ if it is not vaccinated. If it gets the vaccine, its odds of dying are assumed to be (close to) zero. Let parents have access to the treatment at cost C and let log family income be y (for simplicity, we will assume that there is one child per household). We assume that y is logistically distributed across families with mean $\overline{y_t}$ and variance σ_y^2.[5] We can therefore write

$$y_t = \overline{y_t} + \epsilon, \tag{1}$$

where the family-specific error term, $\epsilon \sim \mathcal{L}(0, \sigma_y^2)$. Now, assume that the net benefit of having one's child vaccinated will be positive if the costs are less or equal to a fraction S of family income.[6] Thus, a child's probability of receiving the vaccine is given by

$$P(c \leq s + y_t), \tag{2}$$

where lower case letters denote logs of the variables. Rearranging and substituting using (1) yields $P(c \leq s + \overline{y_t} + \epsilon) = P(\epsilon > c - s - \overline{y_t}) = 1 - P(\epsilon \leq c - s - \overline{y_t})$. By the law of large numbers, the under-five mortality rate at time t is given by $mr_t = \overline{mr} \cdot P(\epsilon \leq c - s - \overline{y_t}) = \overline{mr} \cdot F(c - s - \overline{y_t})$, where $F(x) = (1 + e^{-(x/\sigma_x)})^{-1}$ is the *cdf* of the logistic distribution (i.e. the logistic function). Substituting the expression for $F(\cdot)$ into the above equation yields

$$mr_t = \overline{mr} \cdot (1 + e^{(\overline{y_t} + s - c)/\sigma_y})^{-1}. \tag{3}$$

If per family income in this economy grows exponentially at rate γ, log incomes will be a linear

[5] Empirically, the logistic distribution is often found to yield a fairly good approximation to income data and is widely used in applied empirical work (e.g. Bourguignon [2003] and Klasen and Misselhorn [2008]).

[6] We can think of a quasi-linear utility function in which case a consumption good is consumed until the marginal utility of consuming more falls below the utility of purchasing the medical treatment.

function of time:

$$\overline{y_t} = y_0 + \gamma t, \tag{4}$$

where y_0 is a country-specific starting point. Plugging (4) into the mortality rate equation (3) we have

$$mr_t = \overline{mr}(1 + e^{-\beta(t-a)})^{-1}, \tag{5}$$

where $a = (y_0 + s - c)$ and $\beta = -\gamma/\sigma_y$. This expression is recognized as the three parameter-logistic function with parameters $\overline{mr}$, a, and β. Note that β is negative as mortality decreases over time.

As for the characteristics of the logistic function, note that

$$\dot{mr}_t = \beta \cdot \left(mr_t - \frac{mr_t^2}{\overline{mr}} \right) \tag{6}$$

and thus

$$\frac{\dot{mr}_t}{mr_t} = \beta \cdot \left(1 - \frac{mr_t}{\overline{mr}} \right), \tag{7}$$

where the dot denotes the derivative with respect to time.[7] mr_t therefore changes at rate β for $mr_t \to 0$ and at rate zero for $mr_t \to \overline{mr}$. It is easy to show that if mortality is a decreasing function of time (i.e. $\beta < 0$), $\ddot{mr}_t$ is negative for $t < a$ and positive thereafter. It can also be shown that the function is symmetric around its point of inflection $t = a$. A country will have reduced mortality to $\overline{mr}/2$ at time $t = a$. According to (6), absolute reductions in mortality will first increase and then decrease after the country has achieved the half-way mark. Thus, the logistic growth curve captures the dependence of rates of reduction on initial values.

While this model explains why the transition towards low levels of under-five mortaltiy would

[7] At first sight, this prediction seems to be at odds with the left panel of figure 1 since absolute changes do not seem to follow a quadratic function. However, as we will argue below, most countries are likely to have already passed the halfway mark on their way to low levels of mortality so that absolute changes are infact highest for lagging countries. We take up this point again when we analyze historical data on infant mortality rates in section 4.3

follow a logistic growth path, it has obvious limitations. It implies that progress in reducing under-five mortality is a consequence of economic growth. Several recent contributions have argued that while there is a role for economic growth in bringing down rates of mortality and improving health in general [Pritchett and Summers, 1996, Fogel, 2004], growth is often found to be trumped by other factors, in particular technological change and maternal education (through improving the efficiency of inexpensive and readily-available technologies) [Easterly, 1999, Hanmer et al., 2003, Deaton, 2004, Jamison, 2006, Kenny, 2009].[8]

However, it is straightforward to show that if technological change is modeled as exponentially decreasing costs of the treatment C, i.e. $C = C_0 e^{-\phi t}$, the main conclusions remain unaltered. This can be seen by taking logs and plugging the expression into equation (2). The expressions for a and β are then $c_0 - s - y_0$ and $-\gamma+\phi/\sigma_y$, respectively, that is, the speed of reduction is now higher all else equal.

The interpretation of this pattern is as follows. Initially, only the wealthiest will enjoy low mortality rates as they are the only ones who have access. As incomes grow (or, alternatively, as new technologies are introduced or become cheaper) the middle class will also gain access. This is the point where the absolute proportional decrease in mortality is largest, the maximum of equation (6). Further reductions in mortality are increasingly difficult to achieve since now the poorest segments of the population have to be covered.

It should also be noted that the model makes two other important predictions: first, note that the speed of transition β is an inverse function of income inequality measured by the standard deviation of log per unit income. We would therefore expect to see slower transitions in countries with higher income inequality, a prediction that we will test in section 7. Second, the model implies that within-country inequalities in health outcomes will follow an 'inverted U' as in Oster [2009]—inequality will increase as the most privileged parts of society gain access to services such as health care and education and later decreases after half of the population has gained access.

[8] While nearly all studies find a strong relationship between *levels* of income per capita and indicators of overall health like mortality and life expectancy [e.g. Preston, 1975], the association between *changes* in these variables is often found to be much weaker [Pritchett and Summers, 1996, Easterly, 1999, Kenny, 2009].

4 Estimating transition paths: the mortality transition

4.1 Data and estimation

Since we have panel data, we need to account for different average mortality rates for countries. We can do so by introducing a country-specific point of inflection a_i for country i:

$$mr_{it} = \overline{mr}(1 + e^{-\beta(t-a_i)})^{-1}. \tag{8}$$

Rearranging and taking logs yields

$$-\ln\left(\frac{1}{mr^*_{it}} - 1\right) = \beta(t - a_i), \tag{9}$$

where $mr^*_{it} = {}^{mr_{it}}/_{\overline{mr}}$.

Thus, the normalized and transformed indicator can be estimated by

$$-\ln\left(\frac{1}{mr^*_{it}} - 1\right) = \alpha_i + \beta t + \epsilon_{it}, \tag{10}$$

where $\alpha_i = -\beta \cdot a_i$ is a country-fixed effect and ϵ_{it} is the usual error term.

Note that in going from equation (8) to equation (9) we loose all country-year observations for which $mr_{it} \geq \overline{mr}$ as these are no longer defined. In this application, $\overline{mr}$ is a normalizing constant which can be interpreted as the highest conceivable mortality rate.[9] In order to be able to estimate equation (10) via OLS we first have to fix this constant. One might choose $\overline{mr}$ on the basis of historical experience. The highest under-five mortality rate in the data is reported for Mali at 449.8 deaths per 1,000 in 1960. However, mortality was probably as high or higher than that prior to the onset of the international epidemiological transition which led to a rapid decline in mortality in developing countries after 1940.[10] An alternative would be to estimate $\overline{mr}$ from the relationship depicted in the right panel of figure 1. We fix $\overline{mr}$ at 488 deaths per 1,000 as that is the point at

[9] Alternatively, $1 - \overline{mr}$ can be interpreted as the 'natural' survival rate, i.e. the survival rate absent any medical interventions.

[10] Most of this decline was driven by the rapid spread of new technologies and practices. See Stolnitz [1965].

which the regression line in figure 1 intersects with the abscissa.

Our goal here is to estimate the average transition speed in order to use it as a yardstick against which progress can be measurend. Thus, we do not allow the speed of transition β to vary across countries. If one's goal was to specify the model to best fit the data, one could allow for region- or even country-specific transition speeds, whenever there are enough observations per country. In that case we could interact t with the appropriate dummy variables to obtain an estimate of a country's transition speed. However, since we are interested in estimating an 'average' transition speed, we stick to this model as simple as it may be.

To estimate transition paths for under-five mortality, we rely on data from the WDI 2011 database. In order to limit the potentially biasing effect of imputation methods used to construct these time series, we restrict our sample to observations for 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, and 2010 and eliminate all in-between observation. For this series data coverage increases over time from 101 observations in 1960 to 123, 143, 153, 173, 187, and then 192 observations in 1990. Finally, for 1995, 2000, 2005, and 2010 we have observations for 192 countries. Thus, selection effects are negligible if we only consider the last two decades.

4.2 Results

In table 2 we report results for estimating equation (10) via OLS using the transformed data for under-five mortality as the dependent variable for different samples. Since imposing a constant speed of transition introduces within-group serial correlation, all standard errors reported in table 2 are clustered around the country-identifier.

The first column in table 2 reports results for the entire dataset as described above. The estimated transition speed (the coefficient on t) is highly significant and suggests an at-the-limit rate of reduction of 4.2 percent per year, slightly lower than the rate of reduction required to meet MDG4. This is not to say that countries cannot reduce mortality at a higher speed as this is just an 'on average'-statement. However, note that this is the average speed of reduction as the mortality rate tends to zero. As is often the case for fixed-effects models, the R^2 is quite high, implying that the the model explains 96 percent of the overall variation in the data. What is more important is the within-R^2: despite the simplicity of the model with t as the single time-varying predictor, it explains about 80 percent of the within-country variation in the transformed data.

In addition, we can also inspect the fit of the model visually by calculating what Clemens [2004] refers to as *adjusted years*. This is the difference between the year of the data points and $\hat{\alpha}_i/\hat{\beta}$. In effect, we re-adjust all datapoints so that all individual transition paths pass through $\overline{mr}/2$ in adjusted year zero. The resulting scatter plot and our estimate of the transition path estimated in column 1 of table 2 are given in figure 2.

Column 2 reports results for the subsample of low and middle income countries (LICs & MICs) as defined by the World Bank. The coefficient on t is only marginally smaller in absolute terms. In column 3 we restrict the sample size further to include only observations for the 1990–2010 subperiod. As pointed out before, selection effects should be of no concern for this particular subsample. Again, the coefficient remains virtually unchanged. We conclude that the transition path model is fairly general.

As discussed, data on under-five mortality are available with broad country and time coverage, limiting the degree to which selection bias might affect our results. On the other hand, the data reported are only estimates, the foundations for which might be weak in some cases.[11] Thus, one might suspect that the good fit of the model is in fact due to some particular feature of the method used to construct the data set.

To check for the robustness of these results we therefore turn to estimates of under-five mortality derived from Demographic and Health Surveys (DHS) and Reproductive Health Surveys (RHS), which can be accessed through the MEASURE DHS webpage (www.measuredhs.com). The statistics are based on representative household surveys and should therefore not be subject to bias resulting from features of the estimation procedure. If a survey was conducted over two successive years, we attribute results to the first year. The drawback here is that coverage is less comprehensive. Overall, there are 55 countries in which more than two surveys have been conducted between 1985 and 2010 resulting in a total of 186 country-year observations.

Results from using DHS data are reported in column 4 of table 2. Note that the DHS data cover

[11] For a review and discussion of the method used to estimate under-five mortality rates, see Silverwood and Cousens [2008].

developing countries for the 1985–2010 period. Thus, the estimate of the transition speed should be compared to that in column 3. We find a marginally lower estimate on t in absolute terms while at the same time the standard error is about two and a half times as large due to the small sample size. The fit of the model is still very good as indicated by a within-R^2 of 0.59. Figure 3 plots actual observations from this dataset against adjusted years.

4.3 The mortality transition in industrialized countries, 19th and 20th century

In order to further put our results concerning the typical transition speed into perspective, we compare the experience of today's developing countries with a sample of today's industrialized countries during their respective mortality transitions. While there is no readily-available comparable data on under-five mortality that covers the mortality transition in today's industrialized countries, Mitchell reports data on infant mortality that goes back to the 18th century for some countries which may be used for comparison with data on infant mortality from the WDI [see Mitchell, 2003, pages 80–92, and sources cited there]. We consider time series data for six Northern European countries which have experienced high regional integrity over time and otherwise (apparent) consistency in their annual data series: Denmark (1835–1998), England & Wales (from 1850), Finland (1866), the Netherlands (1840), Norway (1836), and Sweden (1800).

Consider first figure 4, where average relative changes (in percent) are plotted against initial levels for each country individually.[12] While we see that countries clearly started at initial average levels of infant mortality before embarking on their respective transitions, their is clearly an inverse relationship between relative subsequent changes and initial levels of infant mortality. Relative changes in excess of 4.1 percent over the period of 25 years are the exception when the intial levels are in excess of a mortality rate of 100 per 1,000 livebirths.

The fact that these data series actually cover the onset of the mortality transition in these countries also allows us to check a second feature of the logistic transition path-model outlined above, namely that according to equation (6), absolute changes are a quadratic function of initial

[12] Mitchell [2003] reports data until 1998 so that the last observation here is for initial year 1973.

infant mortality rate. We were unable to test this prediction with data on under-five mortality rates for the 1960–2010 period since, as noted earlier, even most of the least developed countries will probably have made some progress towards lower levels of under-five mortality by 1960. Consider figure 5, which depicts the relationship between absolute changes over 25 years against initial levels. It seems that, while severely affected by heteroskedasticity, the quadratic function provides a good fit to the data. Testing this presumption formally by regressing absolute changes on infant mortality rate, its square, and a constant confirms this (results not reported): we find a positive coefficient on all squared terms and the null hypothesis of no quadratic relationship (an insignficant coefficient on the squared term) is rejected (p-value < 0.05) for Denmark, England & Wales, Finland, and the Netherlands. Only for Norway and Sweden is the null not rejected at conventional levels of signficance. These results are not necessarily authoritative since the time periods considered overlap and, thus, observations are not independently distributed. Nevertheless, we believe the results lend some support to the transition path-model based on a logistic growth curve.

How does the industrialized countries' experience compare to the experience of developing countries over the last 50 years? Table 3 reports results of the estimation of transition paths. To ensure comparability, we limit the dataset to quinquennial observations for the historical data series, i.e. only data for the years 1800, 1805, ..., 1995 is used. It should be kept in mind, that the historical data are from vital registration systems whereas the WDI data are mostly estimated. As an upper bound for the infant mortality rate we choose, somewhat arbitrarily, 250 deaths per 1,000. However, changing this cut-off for the transformation does not change our results significantly.

The results reported in columns 1–3 of table 3 reflect those of our earlier analysis of under-five mortality rates in so far as changing the underlying sample and time period from all countries and all years to only LICs & MICs and from 1960-2010 to 1990-2010 does not change our results dramatically. Within-R^2s are generally very high: more than three-fourths of the variation in the data over time are explained by the shape of the logistic curve. Turning to the historical data, we find a somewhat lower coefficient on t, implying that it took today's industrialized countries longer to complete the mortality transition. This is what one would expect if today's developing countries have managed to 'leap-frog' technologies in order to bring about a reduction in infant mortality. Note that even though the underlying data for the estimation in column 4 involve no imputed values, the Within-R^2 is even higher now compared to columns 1–3.

The difference in the transition speed implied by our results in table 3 is depicted in figure 6, where we plot the sample used in column 1 against adjusted years and overlay the plot with transition paths implied by the coefficients in columns 1 (dashed line) and 4 (solid line).

4.4 Discussion

Four things should be noted: first, the estimated transition paths for the 1960-2010 period are fairly general. In particular, the coefficient on t is not sensitive to the development status of the countries in the sample; it does not matter whether we consider all countries for which data are available or just the subset of LICs and MICs. Also, the explained within-group variation remains high.

Second, it should be noted that while the model describes changes over time with reasonable precision, it is silent on when exactly a country embarks on this transition path. The timing of the onset of demographic transitions has been discussed at length elsewhere (e.g. Reher [2004]). What we argue is that once countries have embarked on a mortality transition, progress tends to be remarkably uniform.

Third, the average transition speed is lower and the fit deteriorates when only the last two decades are considered. This is likely due to two factors: first, the HIV/AIDS epidemic in Sub-Sahara Africa has significantly pushed up under-five and infant mortalty rates in that region, causing these countries to significantly diverge from the transition path. Estimated transition speeds are much higher and the fit also improves if we drop Sub-Sahara Africa from the sample (not reported). We will return to this issue in section 5. Second, estimation is based on less within-country variation as almost all countries have managed to reduce mortality rates over time.

Finally, those involved with international goal-setting should concede that progress takes time—in most cases more time than the current MDG framework allows for. To further investigate the implications of these estimates for the MDG4 target, we can do a back-of-an-envelope calculation to arrive at the projected time needed for a reduction in under-five mortality by two-thirds. Inverting

(5) yields

$$t_{mr_t} = \frac{\ln(\overline{mr}/mr_t - 1)}{\beta} - a. \tag{11}$$

Let $\theta \in (0, 1]$. It is straightforward to then calculate

$$t_{(1-\theta)mr_t} - t_{mr_t} = \left(\ln \frac{\overline{mr} - (1-\theta)mr_t}{\overline{mr} - mr_t} - \ln(1-\theta) \right) \Big/ \beta, \tag{12}$$

which gives us the expected time to accomplish a reduction in under-five mortality by θ.

This function is depicted in figure 7 for $\theta = 2/3$. It shows that the lower a country's initial level of under-five mortality, the more likely it is to attain MDG4. The highest under-five mortality rate reported for 1990 is Niger's with slightly more than 300 deaths per 1,000. These estimates predict that it will take such a country about 45–50 years to meet the numerical MDG3 target. However, even countries with low levels of under-five mortality will, on average, still need about 25–30 years to bring about a reduction by two-thirds. This is analogue to our finding that the average rate of reduction tends to the coefficients reported in table 2, which is somewhat lower than the rate of reduction required to meet the target. Hence, most countries will not meet the target: while it is already challenging for countries starting with low inital levels under-five mortality, it is clearly unrealistic for countries starting with high initial levels.

5 Judging progress using performance indices

The previous sections show that, even though each country has its own circumstance, it is still meaningful to speak of *the* mortality transition and *the* education transition as Clemens [2004] puts it. Development takes time and expected improvements in the future depend crucially on the point at which a country is located on the trajectory of the transition path. Countries tend to follow a remarkably uniform transition path. Hence, one can judge countries' progress relative to expected progress (based on past experience). In this section, we do so by calculating *performance indices* for the post-1990 period since 1990 is the baseline year for the numerical targets of the MDGs. We then go on to compare our performance index to the performance measure implicitly defined by the numerical target within the MDG framework, the relative rate of reduction in under-five mortality.

In the case of under-five mortality rates, let $\widehat{mrc}_{t+\tau} = \widehat{mrc}_{t+\tau}(mrc_t, \tau, \beta)$ be the predictor function in the sense that if we observe mrc_t in year t, we expect to observe $\widehat{mrc}_{t+\tau}$ in τ years time based on transition speed β. The predictor function is giben by

$$\widehat{mrc}_{t+\tau}(mrc_t, \tau, \beta) = \overline{mrc}\left(1 + \frac{\overline{mrc} - mrc_t}{e^{\beta\tau} mrc_t}\right)^{-1}. \tag{13}$$

The performance index for country i for period t–$t + \tau$ is then defined as the ratio of actual changes to expected changes based on the estimated transition path.[13] For the time period between the MDG baseline year 1990 and 2010 we have:

$$pi_{i,1990,20} = \frac{mrc_{i,2010} - mrc_{i,1990}}{\widehat{mrc}_{i,2010}(mrc_{1990}, 20, \beta) - mrc_{i,1990}}. \tag{14}$$

A performance index larger than unity indicates overperformance, unity indicates average progress, and an index less than unity indates underperformance. Since our estimates of the transition speed do not differ too much across different samples, we choose the respective βs from the estimations using all observations, that is, the transition speed reported in column 1 in table 2.

Since MDG4 is defined as a relative reduction, the performance index has to be compared to the average annual rate of reduction. First, both indicators, the performance index and the average annual rate of reduction, are highly correlated (the correlation coefficient is 0.93, significant at the one-percent level). This comes as no surprise given that both indicators share the same numerator. However, in comparison with the annual rate of reduction, the main advantage of the performance index is that it does not depend on initial levels. The slope parameter of the regression line in figure 8 is not significant at convential levels. Thus, the performance index does not discriminate against countries with higher initial mortality.

Figure 9 plots the annual rate of reduction against the performance index. The quadrants

[13] Note that comparing actual relative changes to predicted relative changes would yield the same result as the denominator for both is identical.

indicate whether a country is classified as a ‘good performer’ according to the criteria used. An annual rate of reduction larger than 4.3 percent qualifies countries to be classified as ‘on-track’ to meet MDG4. A performance index in excess of unity signals ‘overperformance’ according to our criterion. First, only 38 percent of the 141 developing countries considered in this analysis have achieved the average annual rate of reduction requried to achieve a reduction by two-thirds over 25 years. At the same time, 57 countries have managed to outperform the past trend according to the performance index.

No country is classified as being on-track that is not at the same time classified as an overperformer. While only two countries in Sub-Saharan Africa, Madgascar (4.6 percent) and Malawi (4.3 percent), can be counted as being on-track to meet MDG4 by 2015, there are several countries in Sub-Sahara Africa that have outperformed average progress in the past. These are Niger (1.68), Liberia (1.33), Eritrea (1.18), Tanzania (1.08), Guinea (1.06), and Sierra Leone (1.02). Countries outside Sub-Saharan Africa that fail to reduce under-five mortality at the required speed but that show nevertheless above-average performance are Cambodia (1.17), Bolivia (1.11), the Dominican Republic (1.08), Russia (1.02), Albania, Vietnam and Guyana (all 1.01).

Even though some African countries are clearly overperformers, the region as a whole is still found to be lagging in terms of progress towards MDG4. Table 6 reports population-weighted averages of initial levels, the average annual rate of reduction and performance indices. Clearly, Sub-Saharan Africa trails behind in terms of progress towards MDG4 and so does the Oceania region. Severe underperformers in Sub-Saharan Africa include countries affected by the HIV/AIDS epidemic that coincides with the episode under study, some of which had low levels of under-five mortality in 1990 in comparison to the regional average: South Africa, Botswana, Lesotho, and Zimbabwe. Others are ‘failed states’ such as Chad, the Congos, the Central African Republic, and Somalia.

For the under-five mortality series it is also possible to calculate performance indices for the two decades seperately. The last two columns in table 6 reports population-weighted averages for the 1990-2000 and 2000–2010 sub-periods. These figures support conventional wisdom. In particular, Sub-Saharan Africa’s performance in the 1990s, a decade often refered to as the continent’s ‘lost decade', is reflected in these numbers. Progress is back to normal in West & Central Africa during the last decade, while South & East Africa still suffers the effects of the HIV/AIDS epidemic. We also observe sluggish performance for the formerly Communist countries of Easter Ruope & Central Asia during the 1990s and subsequent normalization during the last decade, something many observers would expect. The low performance index for the Caribbean for the 2000s is driven by the 2010 Haiti earthquake.

In summary, using the performance index rather than the annual rate of reduction does not make much of a difference when comparing progress at the regional level. It does, however, make a difference for individual countries, particularly those with high initial levels of under-five mortality. Criticism where criticism is due; praise where praise is due.

6 Other targets: nutrition, schooling, gender equality

6.1 MDG1C: Hunger

It is possible to apply the method outlined above to indicators used to track progress towards MDG1C which calls for halving the proportion of people who suffer from hunger. There are two indicators that are used in order to track progress towards this goal: the FAO indicator of the prevalence of undernourishment, expressed as the proportion of a population that is not attaining a minimum food energy requirement,[14] and the prevalence of underweight children under five years of age. The FAO indicator is probably flawed [see de Haen et al., 2011, for a recent review of different indicators]: Svedberg [2002] argues that the FAO indicator, which is based on food availability and assumptions about the distribution of calories across populations, is likely to be biased.

Anthropometric measures are superior in so far as they rely on direct observations of the consequences of malnutrition. There are three indicators for children under the age of five: wasting (low weight-for-height) is an indicator of acute undernutrition, stunting (low height-for-age) is an indicator of chronic undernutrition, and underweight (low weight-for-age) is a summary indicator combining both facets. Since we are interested in long-run trends, we focus here on the propor-

[14]See e.g. FAO [2003] for more details on this indicator.

tion of children whose height-for-age is more than two standard deviations below the median for the international reference population ages 0-59 months. The data stem from the WHO's Global Database on Child Growth and Malnutrition and are provided through the WDI.[15]

The series covers a total of 384 country-year observations if only countries with two or more observations are considered. On average, there are 3.4 observations per panel group in the below regression. However, eventhough the earliest observation is for 1966 (Colombia), data coverage increases substantially over time as one would expect given that most observations are based on survey data.

All the above measures have the advantage that they are defined as proportions, i.e. the theoretical upper and lower limit is well-defined. Estimating equation (10) with the transformed stunting rate on the right-hand side yields

$$-\ln\left(\frac{1}{stunted_{it}} - 1\right) = \hat{\alpha}_i \underset{(0.004)}{-0.028^{***}}\, t + \hat{\epsilon}_{it}, \qquad (15)$$

where $\hat{\alpha}_i$ and $\hat{\epsilon}_{it}$ are the esimtates of the country fixed effects and the vector of residuals, respectively, and the standard error of the coefficient on t is given in parentheses.

Hence, the rate of reduction approaches 2.8 percent in the limit. Based on equation (12) this implies that it takes close to 40 years in order to bring about a reduction by one-half when half the children below the age of five are stunted initially. The model explains 32 percent of the variation in the data over time. The fit is illustrated in figure 10.

6.2 The education transition

6.2.1 Data issues

In principle, the method outlined above can be applied to education indicators such as the primary completion rate (the preferred indicator for MDG2) and the gender ratio in education [Meyer et al., 1977, 1992, Clemens, 2004].[16] However, several shortcomings of the official indicators

[15]The data are based on the WHO's child growth standards released in 2006.

[16]While Meyer et al. [1977, 1992] demonstrate that increases in enrolment rates follow and s-shaped transition path, Clemens [2004] additionally considers the gender ratio in education. He assumes log-logistcally distributed

for MDG2 and MDG3 should be noted:

First, while mortality rates are clearly outcome measures, completion or enrollment rates do not actually tell us anything about the quality of education [Filmer et al., 2006]. One could move on to literacy rates (also an official MDG indicator), but data availability is just as poor and the way literacy is assessed in surveys is far from consistent (ibid.).

Second, the *ratio* of girls to boys in primary and secondary education is probably not the best measure to assess gender disparities in education. After all, it is easy to think of situations in which hardly anyone is actually enrolled but the gender ratio signals large disparities. An alternative would be to consider the *gap*, i.e., the difference between attainment rates. This indicator might trace out an inverted-U shape with increasing inequality (boys are likely to have access to schooling first) and decreasing inequality as most boys are already enrolled and more and more girls finally gain access [see Oster, 2009].

Third, the official MDG indicator to monitor progress towards gender equality in education, the ratio of girls to boys in primary and secondary education, implicitly includes the well-known problem of biased sex-ratios at birth and during childhood [see Abu-Ghaida and Klasen, 2004]. Even though this is without doubt an important issue, we believe that it should be dealt with explicitly rather than implicitly. To circumvent this problem one could use the ratio of gross enrollment rates as in Abu-Ghaida and Klasen [2004] and Clemens [2004].[17]

Moreover, there are several data-related problems that make estimating transition paths particularly difficult:

- **The 'upper bound' problem** Conceptually, the primary completion rate is the proportion of children that graduates from primary school in the relevant age bracket. Thus, it should not exceed 100 percent. However, it is proxied by the total number of students in the last grade of primary school minus the number of repeaters in that grade divided by the total number of children of official graduation age. Due to late enrollment (and possibly measurement

wages and costs of schooling, which lead to logistic growth towards high levels of enrollment in a Beckerian model. He also shows that if costs are higher for girls, the ratio of girls to boys follows a logistic growth path as well. For a similar theoretical model of access to health services see Oster [2009].

[17] Gross enrollment rates are calculated by dividing the number of all children enrolled in secondary education divided by the population in that age bracket.

error), our series includes in total 470 observations above 100 percent—almost 20 percent of all country-year observations.[18] Therefore, one faces a trade-off between including as many observations as possible and choosing a plausible upper bound for the transition path.[19]

This problem is also endemic for the official indicator for MDG3, the gender ratio in primary and secondary education, and alternatives like the ratio of gross enrollment rates in secondary education. Almost 48 percent of countries report a ratio of gross enrollment rates larger than one (about 13 percent report a ratio larger 1.1). However, taking the ratio of girls' gross enrollment rates to boys' might attenuate measurement error if the series's errors for a given country-year observation are positively correlated.

- **Unbalanced series and missing observations** While the mortality data are close to a balanced panel with 8–10 observations per country, educational attainment data is highly unbalanced and, since data is not missing randomly, results will be driven by those countries with more frequent data reporting.

  One would also like to have observations for the same two points in time for each country—say, 1990 and 2008—in order to make projections based on estimated transition paths and compare these to actual performance. Instead, one has to rely on near-by observations as outlined below which makes inter-country comparison unviable.

- **The 'relevance' problem** The relevance of MDG2 and MDG3 differs between developing countries. While mortality rates can still be considered high compared to developed countries in almost every developing country, universal primary completion and the elimination in the gender gap in education are MDGs that have been attained in many developing countries, particularly in East Asia, Latin America, and the transition economies. For countries as diverse as Bulgaria, China, Cuba, Indonesia, Jamaica, Jordan, Sri Lanka, Mauritius, Poland, and Romania previous policy efforts have resulted in a primary completion rate of more than

[18] Moreover, the primary completion rate is biased upward as not all children enrolled in the last grade of primary school actually graduate.

[19] Alternatively, one could estimate transtition paths using data on net primary enrollment as in Clemens [2004] and Lay [2010]. However, data availability is poor for this indicator. For example, India reports data for net primary enrollment only from 2000 onward, while China reports data only for the 1990–1997 period. Thus, we cannot compare performance towards MDG2 for the 1990–2008 period for these two countries based on this indicator.

95 percent by 1990. How should these countries be dealt with when comparing progress across countries? More practically, there is no point in relying on observations for these countries for the estimation of transition paths.

The problem is illustrated in figure 11, where we compare the cross-country distribution of secondary enrollment ratios across time (censored at 1.1). While the distribution was fairly spread out in 1970, more and more lagging countries managed to catch up over time.[20]

Figures 12 and 13, where we use data on primary completion rates and the ratio of gross enrollment rates for the 1970–2009 period (both taken from the World Development Indicators 2010), illustrate transition paths for educatio indicators. The fit is, predictably, lower than in the case of mortality rates.

To summarize, while it would be possible to apply the method to education indicators as demonstrated by Clemens [2004], the data problems outlined above make this a less attractive excercise. From a policy perspective, it would clearly be preferable to move on to indicators of actual education achievements as proposed by Filmer et al. [2006].

7 Regression analysis

7.1 Data and descriptive statistics

In this section we investigate correlations for our performance index for under-five mortality for the 1990–2009 period using explorative regressions. Eventhough we will not be able to rule out endogeneity issues, we believe that the analysis is still helpful as it allows us to check the plausibility of our index as a measure of performance.

We estimate the following model:

$$pimrc_i = \mathbf{X}'\delta + \mu + \nu_i, \tag{16}$$

[20] The dissolvement of the former Soviet Union after 1990 added some countries with gender ratios around unity, but the overall picture does not change qualitatively if those countries are omitted.

where $\mathbf{X}'$ is a set of explanatory variables explained below and δ a vector of parameters to be estimated, μ is a complete set of region dummies, and ν_i is an idiosyncratic error term.

$\mathbf{X}'$ includes *growth*, which is the average annual growth rate in GNI per capita (in 2005 international Dollars) over the 1990–2008 period as reported in the World Development Indicators 2010. An expansion of an economy's production of goods and services has the potential to increase the government's capacity to provide public goods such as health care. Moreover, increasing incomes should also be associated with an increase in demand for these goods as well as improved nutrition.[21]

Since it is commonly assumed that parents' education is related to a child's survival probability, we include measures of the population's average years of education in $\mathbf{X}'$. $\Delta educ$ is the absolute change in the adult population's years of education and $\Delta educratio$ is the change in the ratio of females' to males' years of education. Both variables are constructed from the Barro and Lee's (2010) dataset. While it might seem less complicated to include changes in males' and females' years of education separately, including both variables in a regression equation will likely result in a multicollinearity problem due to the high correlation between the two variables Klasen [1999].

While we expect both variables to be positively correlated with *pimrc*, several authors have argued that it is mainly the economic status of women which affects health outcomes and education decisions for children positively [e.g. Caldwell, 1986] and empirical evidence for this conjecture is rapidly accumulating.[22]

$\Delta mepv$ and *av.mepv* are the changes and average levels of the intensity of political violence over the 1991–2008 period, respectively.[23] The original data come from the updated online version of the Major Episodes of Political Violence dataset [see Marshall, 1999], which ranks the intensity of political violence on a scale from 0 to 10 on an annual basis. Clearly, one would expect increases in the intensity of political violence and high average levels to be negatively associated with per-

[21] Pritchett and Summers [1996] find that growth in per capita GDP accounts for roughly 40 percent of cross-country differences in mortaltiy improvements.

[22] Just how important maternal education is in the context of child health is not yet resolved as it is difficult to disentangle the effect of maternal education from effects of unobserved socio-economic and geographic factors. See Desai and Alva [1998] and Kravdal [2004] for a discussion.

[23] Choosing 1991 as the initial year allows us to include more observations, particularly for countries in Eastern Europe and Central Asia. However, changing the initial year to 1990 does not alter the results qualitatively.

formance towards MDG4. $\Delta urban$ is the change in the population share living in urban areas. A higher urbanization rate might facilitate the provision of basic health care. Thus, one might expect to find positive coefficients on this variable. However, as argued by Cutler et al. [2006], initial urbanization had adverse effects on health in the 19th century in today's industrialized countries and—given the level of uncontrolled migration to cities in the developing world—might have similar effects there today.

ΔHIV is the prevalence of HIV prevalence in the adult population (ages 15–49) in 2005 as reported in UNAIDS [2010]. Since the year 2005 corresponds roughly to the climax of the HIV/AIDS epidemic in most of the affected African countries, we believe that this variables is a useful proxy for the severity of the epidemic in these countries. We expect this variable to have a negative association with *pimrc*.[24] It would be preferable to use prevalence of HIV among children rather than among adults but the latter should be a fairly good proxy for the former. Moreover, HIV prevalence among adults could also have an important effect over and above the increasing risk of infection for children as is often argued in the context of AIDS orphans.

Δdpt is the change in the proportion of children aged 12-23 monts that have been immunized against diptheria, pertussis, and tetanus (DPT). Rather than stressing the importance of this particular vaccination, we include this variable because it serves as a proxy for changes in the effectiveness with which the government provides health services.

Moreover, we include two variables that are frequently employed in growth regressions. In section 3 we argue that a country's speed of transition is negatively associated with income inequality. We therefore include the Gini index (*gini*) in our regression equation. We expect to find a negative sign on this variable.[25] Alesina et al. [1999] also argued that ethnic divisions account for insufficient provision of public goods such as education. Therefore, we also include the index of ethno-linguistic fractionalization ($frac$) developed by Alesina et al. [2003].[26] Both these variables generally do not

[24] Since it is impossible to accurately estimate HIV prevalence if is very low, the data will only indicate if the estimate is smaller than 0.1 without stating a more precise figure. In our dataset we replace all those values with zero since a prevalence rate of less than a tenth of a percent is, for all practical purposes, zero.

[25] The data come from the WDI 2011 dataset. Since data availability is sparse, we use the observation that is closest to the year 2000.

[26] The index is calculated as the probability to randomly choose two individuals from a given population that belong to the same ethno-linguistic group. [See Alesina et al., 2003] for a discussion of alternative measures.

show much variation over time so that the exact year the figures are attributed to are of minor importance. Summary statistics of all variables are reported in table 7.

7.2 Regression results

Regression results from estimating three different specifications of (16) for under-five mortality via OLS are reported in table 8. As expected, the coefficient on economic growth has a positive sign and is significant in all specifications. All else equal, an increase in the growth rate by one percentage point is associated with an increase by 0.04–0.05 points in *pimrc*. However, it is possible that there is a spurious relationship between economic growth and reductions in child mortality. In particular, technological change could be driving both variables.

The coefficient on $\Delta educ$ is positive throughout with an additional year of education increasing the performance index by about 0.06 points but this relationship fails to be significant. We do find a positive relationship between changes in the ratio of females' to males' years of education and *pimrc* in most of the regressions. This association is also important in terms of economic significance: an increase in the ratio of 0.1 is associated with an increase in *pimrc* by roughly 0.1 points. The only two specifications in which the coefficient drops and ceases to be significant are those in which ΔDPT is included as an additional regressor. This could mean that a more equal distribution of education between women and men affects under-five mortality through higher uptake of health care services.

The urbanization rate enters with the expected sign but is insignificant throughout. The signs on $\Delta mepv$ and *av.mepv* are negative in all regressions and the coefficients are significant in most specifications as expected. The results for *gini* and $frac$ are interesting. While the Gini coefficient enters with a negative sign as expected, the fractionalization index enters with a positive sign in column 8. In any case, all coefficients on these variables are not significantly different from zero. Since $frac$ and *av.mepv* turn out to be highly correlated (correlation coefficient of 0.20 based on 159 observations with a p-value of 0.01), we suspect that both variables affect under-five mortality indirectly through their effect on political stability. Accordingly, the coefficient on *av.mepv* drops and becomes insignificant whenever these variables are included.

Both Δdpt and Δhiv have the expected signs, but only the former is significant at conventional levels (columns 5–7 and 9). The estimates implies a moderate effect of immunization campaigns on *pimrc*: all else equal, an increase in the proportion of children immunized by ten percentage points is associated with an increase in *pimrc* by about to 0.07 points. However, as outlined above, one should not think of this result as implying that immunizing children against DPT is of predominant importance. It is more likely that increasing the overall effectiveness of public health campaigns should be a priority.[27]

8 Conclusion

Compared to earlier efforts of international goal-setting, one of the major innovations of the MDG process has been the introduction of numerical targets, some of which are measurable and time-limited. If international goal-setting for the developing community is to remain a successful venture, both with respect to galvanizing support and delivering the goods, goals should also be realistic. This paper demonstates that targets like achieving universal primary education, gender parity in education, or a reduction in under-five mortality by two-thirds are insurmountable for the least developed countries. Hence, the poorest countries will fail to reach the goals by 2015. This feature of the MDG framework jeopardizes the broad public support the MDG process has received in the past and, as these countries are typically the main benficiaries of development assistance, might cause 'aid-fatigue' in donor countries for years to come.

At the same time, we find that once countries embark on a transition towards low levels of mortality, progress often tends to follow a very similar pattern with increasing rates of reduction over time. The performance index proposed in this paper is based on the idea that reductions over a given period of time can be compared to expected progress based on this 'average' transition path.

For example, applying this index to the main target under MDG4, the reduction of under-five

[27] To illustrate this point, changes in the vaccination rates for DPT and measles are highly correlated (correlation coefficient of 0.78 based on 117 observations, p-value < 0.001). Which one is more important? This is not a question that one can answer on the basis of macro data as including both in one regression would result in excessively large standard errors.

mortality, we find that while only 37 out of the 141 developing countries considered in this analysis have so far achieved the average annual rate of reduction requried to bring about a reduction by two-thirds over 25 years, 56 countries have managed to outperform the past trend according to the performance index. While only two countries in Sub-Sahara Africa can be counted as being on-track to meet MDG4 by 2015, there are ten countries in the region that have outperformed average progress since 1990—in a global environment that was without doubt less conducive to development than during previous decades. However, comparing progress to past experience also reveals that at the regional level, Sub-Sahara Africa is still found to be lagging behind.

The performance index proposed in this paper consitutes an adequate method to arrive at realistic targets. We demonstrate that our method can be used to calculate performance indices for different MDG indicators such as mortality rates, primary completion rates, and the gender ratio in education. However, this venture is less attractive in the case of MDG2 and MDG3. It is important to note that this is not a shortcoming of this particular method, but rather a general problem of the indicators employed within the MDG framework.

Moreover, two things should be noted concerning the politico-economic aspect of international goal-setting: first, while achieving average progress on one of the MDGs' numerical targets is certainly realistic, it might well be advantagous for countries to adopt more ambitious goals. However, this does not run contrary to our main assertion that goals should be realistic and should not systematically put certain countries at a disadvantage. In addition, as argued by Bourguignon et al. [2008], it is difficult to imagine that governments will be any less ambitious once they signed-up to specific targets that are achievable. The MDGs might thus act as a minimal standard for progress at the country-level.

Second, the call for 'universal primary education' might be a much more powerful one compared to a call for 'above-average' progress towards this long-term goal. Development advocates might find the former much more useful in order to galvanize initial support. However, it is also not difficult to see how such a call, once turned into a promise, turns out to be a recipe for disappointment and fatigue.

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A Tables

Table 1: Descriptive statistics: under-five mortality, 1960–2010

Year	Obs.	Mean	Std. Dev.	Min.	Max.
1960	101	162.2	104.8	19.4	449.8
1970	143	130.9	82.7	13.3	371.1
1980	173	95.9	76.8	8.5	314.6
1990	192	71.7	66.7	6.3	311.0
2000	192	56.8	57.0	3.9	232.8
2010	192	42.3	46.8	1.9	180.0

Notes: Based on WDI 2011 data.

Table 2: Fixed effects-estimates for under-five mortality

	(1)	(2)	(3)	(4)
Dep. variable:	$-\ln(1/u5mr^*_{it} - 1)$			
	All	LICs & MICs		DHS data
	1960–2010	1960–2010	1990–2010	1985–2010
t	-0.042^{***}	-0.039^{***}	-0.037^{***}	-0.035^{***}
	(0.001)	(0.001)	(0.002)	(0.005)
R^2	0.96	0.95	0.98	0.99
Within-R^2	0.84	0.83	0.74	0.59
Obs.	1,840	1,355	705	186
No. of groups	192	141	141	55

Notes: Clustered standard errors in parentheses. *, **, and *** denote significance at the ten-, five-, and one-percent level, respectively. Based on WDI 2011 data

Table 4: Initial levels of primary completion, projected level, actual level, and performance index by developing region, c. 1990–2009.

		Primary completion rate			Performance
Country	Period	Initial	Projected	Actual	Index
South & East Africa					
Comoros	1992–2008	39.6	56.9	81.0	2.40
Djibouti	1990–2008	32.0	50.5	2.9	-1.57

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Table 4 —continued from previous page

Country	Period	Primary completion rate Initial	Projected	Actual	Performance Index
Eritrea	1994–2008	18.0	28.4	46.9	2.78
Ethiopia	1994–2008	14.9	23.9	52.1	4.10
Lesotho	1990–2007	58.4	75.4	72.7	0.84
Madagascar	1990–2008	37.0	56.2	71.2	1.78
Malawi	1990–2007	28.1	44.7	54.0	1.56
Mozambique	1990–2008	26.4	43.7	59.4	1.91
Namibia	1992–2008	74.4	86.7	80.8	0.52
Rwanda	1992–2008	44.2	61.6	54.0	0.56
South Africa	1991–2007	75.9	87.8	85.8	0.83
Swaziland	1990–2007	62.7	78.8	72.0	0.58
Tanzania	1992–2007	55.3	70.9	82.6	1.76
West & Central Africa					
Benin	1990–2008	19.5	34.1	65.1	3.12
Burkina Faso	1990–2008	19.3	33.9	38.0	1.28
Burundi	1990–2008	40.9	60.3	45.2	0.22
Cameroon	1990–2008	54.2	72.8	72.7	1.00
Cape Verde	1990–2008	53.6	72.2	92.0	2.06
Central African Republic	1990–2008	30.4	48.6	35.5	0.28
Chad	1990–2007	16.3	28.5	30.9	1.20
Congo, Dem. Rep.	1991–2008	48.4	66.7	53.2	0.26
Congo, Rep.	1990–2008	58.8	76.6	73.1	0.80
Cote d'Ivoire	1990–2008	40.1	59.5	47.7	0.40
Gabon	1992–2003	62.0	73.0	69.5	0.69
Gambia, The	1992–2008	45.1	62.4	79.1	1.96
Ghana	1991–2008	63.7	79.6	82.2	1.16
Guinea	1990–2008	18.8	33.2	54.7	2.50
Mali	1991–2008	12.0	21.7	56.8	4.59
Mauritania	1990-2008	29.1	47.0	64.2	1.96
Niger	1990–2009	15.8	29.5	40.3	1.79

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Table 4 —continued from previous page

		Primary completion rate			Performance
Country	Period	Initial	Projected	Actual	Index
Sao Tome and Principe	1990–2009	77.9	90.7	84.8	0.54
Senegal	1990–2008	41.9	61.4	56.3	0.74
Togo	1990–2007	35.0	52.9	61.3	1.47
Middle East & North Africa					
Algeria	1990-2008	80.8	92.0	113.9	2.96
Iran, Islamic Rep.	1990-2007	83.9	93.4	116.8	3.46
Iraq	1993-2005	57.6	70.1	76.3	1.50
Morocco	1990-2008	51.4	70.3	81.3	1.58
Tunisia	1990-2008	80.3	91.7	92.8	1.10
South Asia					
Afghanistan	1993–2005	28.5	39.9	38.8	0.90
Bhutan	1993–2009	24.3	38.8	88.5	4.42
India	1995–2007	73.9	83.7	93.6	2.02
Nepal	1991–2002	51.1	63.0	70.0	1.59
East Asia					
Cambodia	1994-2008	45.4	60.6	79.5	2.24
Lao PDR	1990-2008	44.6	64.0	74.7	1.55
Mongolia	1995-2008	74.4	84.7	93.3	1.83
Latin America					
Bolivia	1990-2007	71.4	85.3	97.7	1.90
Colombia	1990-2008	73.8	87.5	110.5	2.67
Costa Rica	1990-2008	74.4	87.9	92.9	1.37
El Salvador	1991-2008	65.0	80.6	89.4	1.56
Guatemala	1985-2008	38.7	63.3	80.0	1.68
Honduras	1991-2008	64.0	79.8	89.7	1.63
Nicaragua	1990-2008	39.2	58.5	74.5	1.83
Panama	1985-2008	82.4	95.0	101.9	1.54
Paraguay	1990-2007	65.2	80.7	94.5	1.89

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Table 4 —continued from previous page

Country	Period	Primary completion rate Initial	 Projected	 Actual	Performance Index
Venezuela, RB	1990-2008	78.8	90.8	95.4	1.39
Caribbean					
Dominican Republic	1994-2008	61.0	74.9	90.7	2.14
Grenada	1985-2008	84.6	96.1	114.4	2.59
Vanuatu	1992-2007	83.4	92.2	79.3	-0.47
Eastern Europe & Central Asia					
Georgia	1995-2008	83.5	91.3	99.7	2.08
Kazakhstan	1994-2009	46.7	62.9	104.8	3.58
Latvia	1995-2008	73.3	83.9	95.1	2.05
Uzbekistan	1994-2008	79.9	89.3	94.7	1.57

Notes: Only countries for which the primary completion rate at the beginning of the period was below 85 percent.

Table 5: Initial levels of gender ratio in secondary education, projected level, actual level, and performance index by developing region, c. 1990–2009.

Country	Period	Gender ratio Initial	 Projected	 Actual	Performance Index
South & East Africa					
Comoros	1990–2005	0.71	0.83	0.76	0.39
Djibouti	1990–2008	0.69	0.84	0.70	0.01
Ethiopia	1991–2008	0.75	0.88	0.72	-0.25
Kenya	1985–2008	0.75	0.91	0.92	1.04
Malawi	1990–2008	0.57	0.74	0.85	1.66
Mozambique	1990–2008	0.57	0.73	0.75	1.09
Rwanda	1990–2008	0.71	0.85	0.90	1.34
Somalia	1985–2007	0.55	0.75	0.46	-0.45
Uganda	1990–2008	0.58	0.74	0.85	1.68
West & Central Africa					

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Table 5 —continued from previous page

Country	Period	Primary completion rate Initial	Projected	Actual	Performance Index
Benin	1990–2005	0.42	0.56	0.57	1.04
Burkina Faso	1990–2009	0.52	0.70	0.74	1.23
Burundi	1990–2008	0.62	0.78	0.71	0.54
Cameroon	1990–2008	0.69	0.83	0.80	0.77
Central African Republic	1990–2008	0.40	0.57	0.57	1.03
Chad	1990–2007	0.22	0.34	0.45	1.85
Congo, Dem. Rep.	1992–2008	0.48	0.63	0.55	0.47
Congo, Rep.	1990–2004	0.76	0.86	0.86	1.00
Cote d'Ivoire	1985–2002	0.43	0.59	0.56	0.76
Gambia, The	1990–2008	0.47	0.64	0.94	2.76
Ghana	1990–2008	0.67	0.82	0.89	1.46
Guinea	1990–2008	0.34	0.50	0.59	1.53
Mali	1990–2008	0.49	0.66	0.64	0.85
Mauritania	1990–2007	0.47	0.63	0.89	2.59
Niger	1990–2008	0.37	0.54	0.6	1.37
Nigeria	1990–2007	0.76	0.88	0.77	0.13
Senegal	1990–2008	0.51	0.68	0.81	1.75
Sierra Leone	1990–2007	0.49	0.66	0.66	1.05
Sudan	1991–2009	0.79	0.91	0.88	0.74
Togo	1990–2007	0.34	0.49	0.53	1.22
Middle East & North Africa					
Algeria	1990–2005	0.77	0.88	1.08	2.84
Egypt, Arab Rep.	1990–2004	0.77	0.87	0.94	1.72
Iran, Islamic Rep.	1990–2008	0.72	0.86	0.98	1.88
Iraq	1993–2005	0.64	0.75	0.67	0.30
Morocco	1990–2007	0.71	0.84	0.86	1.08
Syrian Arab Republic	1990–2008	0.72	0.86	0.98	1.84
Tunisia	1990–2008	0.77	0.89	1.08	2.49
South Asia					

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Table 5 —continued from previous page

		Primary completion rate			Performance
Country	Period	Initial	Projected	Actual	Index
Afghanistan	1991–2007	0.51	0.67	0.38	-0.88
Bangladesh	1990–2007	0.51	0.67	1.05	3.37
Bhutan	1988–2009	0.25	0.41	0.99	4.46
India	1990–2007	0.58	0.74	0.86	1.77
Nepal	1990–2006	0.44	0.59	0.89	2.95
Pakistan	1990–2008	0.42	0.59	0.76	1.99
East Asia					
China	1990–2008	0.74	0.87	1.05	2.32
Indonesia	1990–2008	0.84	0.94	0.99	1.47
Lao PDR	1990–2008	0.68	0.83	0.81	0.83
Latin America					
Bolivia	1986–2007	0.82	0.94	0.97	1.21
Caribbean					
Solomon Islands	1990–2007	0.64	0.78	0.84	1.40
Vanuatu	1991–2004	0.80	0.89	0.86	0.75
Eastern Europe & Central Asia					
Turkey	1990–2008	0.61	0.77	0.89	1.71
Uzbekistan	1986–2008	0.83	0.96	0.98	1.23

Notes: Only countries for which the gender ratio in secondary education at the beginning of the period was below 0.85.

Table 3: Fixed effects-estimates for infant mortality, 1800–2010, quinquennial observations

	(1)	(2)	(3)	(4)
Dep. variable:	$-\ln(1/imr^*_{it} - 1)$			
	All	LICs & MICs		Hist. data
	1960-2010	1960-2010	1990-2010	1800-1990
t	-0.042^{***}	-0.039^{***}	-0.036^{***}	-0.029^{***}
	(0.001)	(0.001)	(0.002)	(0.002)
Within-R^2	0.84	0.82	0.74	0.88
Obs.	1,840	1,355	705	187
No. of groups	192	141	141	6

Notes: Clustered standard errors in parentheses. *, **, and *** denote significance at the ten-, five-, and one-percent level, respectively. Based on WDI 2011 data (columns 1-3) and data from Mitchell [2003, pages 80–92] (column 4).

Table 6: Initial levels of under-five mortality, average annual rate of reduction, and performance indices by region, 1990–2009

Region	No.	Initial level 1990	Average annual rate of reduction	Performance Index 1990–2010	1990–2000	2000–2010
West & Central Africa	20	143.2	2.1	0.70	0.22	1.08
South & East Africa	27	189.0	1.6	0.61	0.47	0.72
Middle East & North Africa	12	73.3	4.5	1.10	1.14	1.16
South Asia (excl. India)	7	133.0	3.6	1.00	1.12	0.95
India		114.8	3.0	0.91	0.90	0.89
East Asia (excl. China)	11	69.6	3.9	1.03	1.04	1.02
China		48.3	4.7	1.15	0.99	1.36
Oceania	10	74.5	2.1	0.66	0.63	0.62
Latin America	19	49.4	4.6	1.14	1.17	1.22
Caribbean	10	63.3	2.7	0.68	1.03	0.25
Eastern Europe & Central Asia	23	39.7	4.2	1.03	0.79	1.27

Notes: Population weights based on 1990 populations.

Table 7: Summary statistics, c. 1990–2009

Variable	Mean	Std. Dev.	Min	Max	N
$pimrc$	0.84	0.43	−0.49	1.86	141
$growth$	4.28	1.99	−2.1	12.13	114
$\Delta educ$	1.54	1.13	−1.49	3.7	100
$\Delta educratio$	0.1	0.13	−0.28	0.61	100
$\Delta mepv$	−0.84	2.06	−9	5	116
$av.mepv$	0.88	1.51	0	7.33	122
$\Delta urban$	5.44	5.28	−5.3	17.8	142
ΔDPT	0.09	0.18	−0.44	0.6	117
ΔHIV	0.02	0.04	−0.04	0.24	106
$gini$	0.44	0.09	0.28	0.74	114
$frac$	0.49	0.25	0	0.93	135

Table 8: Regression analysis of performance indices for under-five mortality (*pimrc*), 1990–2009

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
growth	0.05***	0.05***	0.04**	0.04***	0.05**	0.04*	0.05*	0.04**	0.05*
	(3.01)	(3.08)	(2.51)	(2.64)	(2.61)	(1.87)	(1.79)	(2.39)	(1.72)
$\Delta educ$	0.06	0.07	0.05	0.06	0.06	0.06	0.07	0.07	0.07
	(1.19)	(1.61)	(1.16)	(1.34)	(1.05)	(1.13)	(1.03)	(1.30)	(0.88)
$\Delta educratio$		1.14***	1.03***	1.02***	0.84**	0.77*	0.54	1.00***	0.53
		(3.72)	(3.34)	(3.22)	(2.04)	(1.87)	(0.98)	(3.03)	(0.90)
$\Delta mepv$			−0.04**	−0.04**	−0.05***	−0.04**	−0.04**	−0.04**	−0.03*
			(−2.35)	(−2.46)	(−2.69)	(−2.25)	(−2.31)	(−2.10)	(−1.71)
av.mepv			−0.04**	−0.04**	−0.05**	−0.04**	−0.05*	−0.03	−0.04
			(−2.08)	(−2.11)	(−2.31)	(−2.15)	(−1.98)	(−1.48)	(−1.21)
$\Delta urban$				−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
				(−0.91)	(−0.94)	(−0.93)	(−0.86)	(−0.75)	(−0.60)
ΔHIV					−1.04		−1.04		−1.29
					(−1.07)		(−1.05)		(−1.03)
ΔDPT						0.64**	0.64*		0.68*
						(2.14)	(1.79)		(1.78)
$frac$								0.03	−0.15
								(0.20)	(−0.89)
gini								−0.30	−0.17
								(−0.44)	(−0.18)
Sub-Sahara Africa	−0.27*	−0.33**	−0.37***	−0.37**	−0.32**	−0.43***	−0.36**	−0.39***	−0.34**
	(−1.86)	(−2.41)	(−2.65)	(−2.61)	(−2.04)	(−3.06)	(−2.21)	(−2.78)	(−2.25)
Middle East & North Africa	0.15	−0.08	−0.10	−0.12	−0.06	−0.05	−0.01	−0.18	−0.08
	(1.06)	(−0.58)	(−0.70)	(−0.79)	(−0.30)	(−0.33)	(−0.08)	(−1.11)	(−0.39)
South Asia	0.12	−0.16	−0.05	−0.09	−0.03	−0.10	−0.05	−0.17	−0.14
	(0.68)	(−1.05)	(−0.31)	(−0.53)	(−0.17)	(−0.56)	(−0.23)	(−1.02)	(−0.60)
Latin America & Caribbean	0.07	0.09	0.02	0.01	−0.03	−0.04	−0.07	−0.00	−0.11
	(0.50)	(0.70)	(0.18)	(0.09)	(−0.18)	(−0.34)	(−0.55)	(−0.01)	(−0.63)
Eastern Europe & Central Asia	0.30*	0.31**	0.24	0.20	0.17	0.26*	0.20	0.16	0.11
	(1.76)	(2.02)	(1.43)	(1.08)	(0.86)	(1.68)	(1.16)	(0.77)	(0.63)
N	88	88	86	86	78	76	68	81	65
R^2	0.40	0.48	0.51	0.52	0.51	0.58	0.57	0.52	0.59
adj. R^2	0.34	0.43	0.45	0.45	0.42	0.50	0.47	0.43	0.46

Notes: Robust standard errors in parentheses. *, **, and *** denote significance at the ten-, five-, and one-percent level, respectively. The reference region is *East Asia & Pacific*. All regression include a constant (not reported).

B Figures

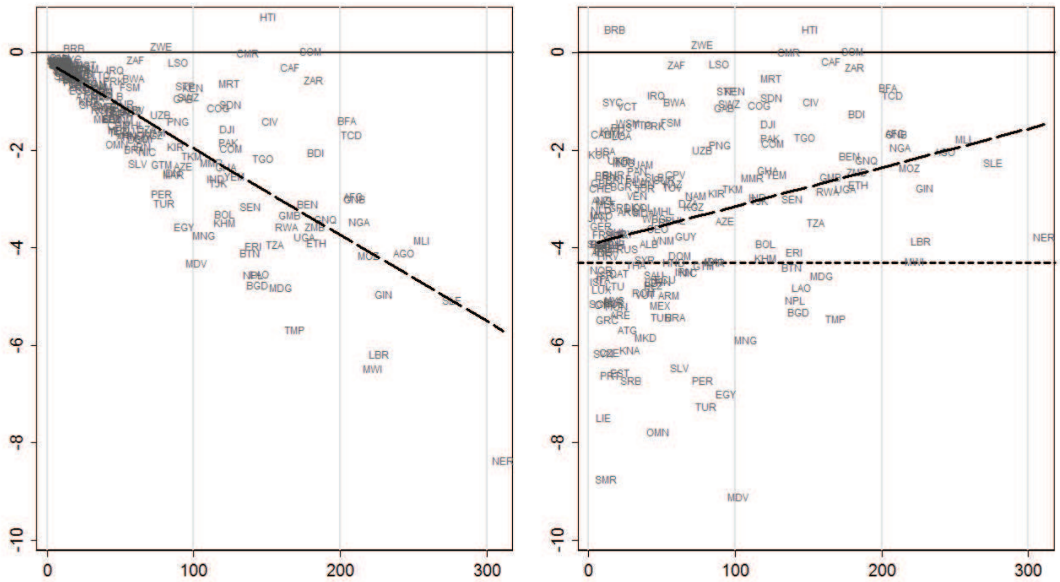

Figure 1: Absolute (left panel) and relative (right panel) annual changes in under-five mortality rate (per 1,000 live births) between 1990 and 2010 against initial levels and regression fit for 192 countries. The horizontal line in the right panel indicates the average annual rate of reduction required to meet MDG4 (about 4.3 percent).

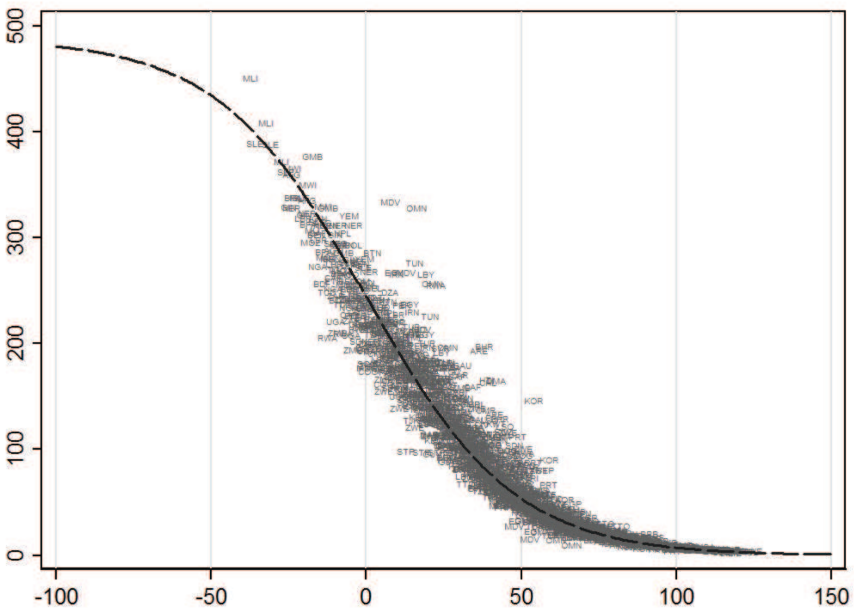

Figure 2: Under-five mortality rates (per 1,000 live births), quinquennial observations for 192 countries between 1960–2010, against adjusted years and fitted transition path (corresponding to column (1) of table 2). Based on WDI 2011 data.

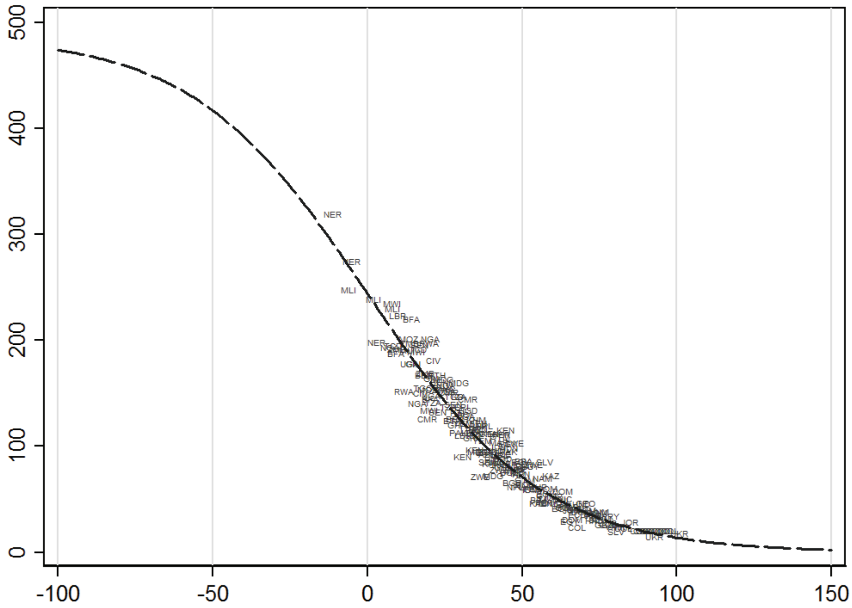

Figure 3: Under-five mortality rates (per 1,000 live births), observations for 1985–2010, against adjusted years and fitted transition path (corresponding to column (4) of table 2). Based on DHS data.

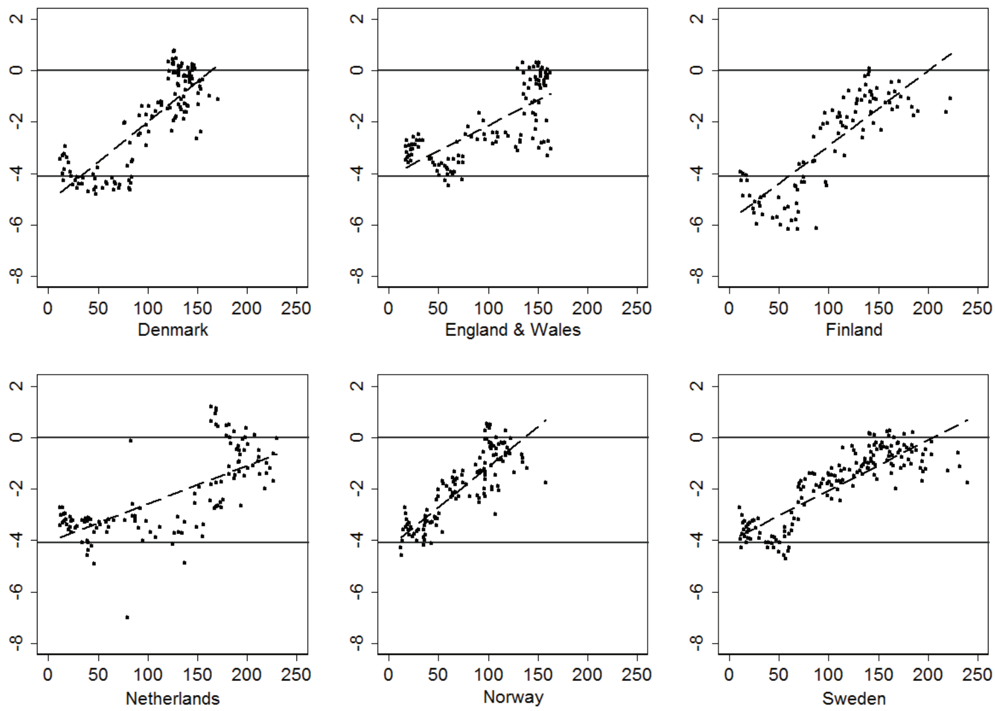

Figure 4: Relative changes over 25 year periods against initial levels of infant mortality (deaths per 1,000 livebirths) and OLS regression lines in Denmark (1835–1973) England & Wales (from 1850), Finland (1866), the Netherlands (1840), Norway (1836), and Sweden (1800). One extreme observation was removed, namely Finland, 1868, for which the reported infant mortality rate was 392 deaths per 1,000 and the subsequent average rate of change −3.95 percent. The lower horizontal line indicates the average annual rate of reduction required to meet MDG4, i.e. 4.3 percent. Based on data from Mitchell [2003, pages 80–92].

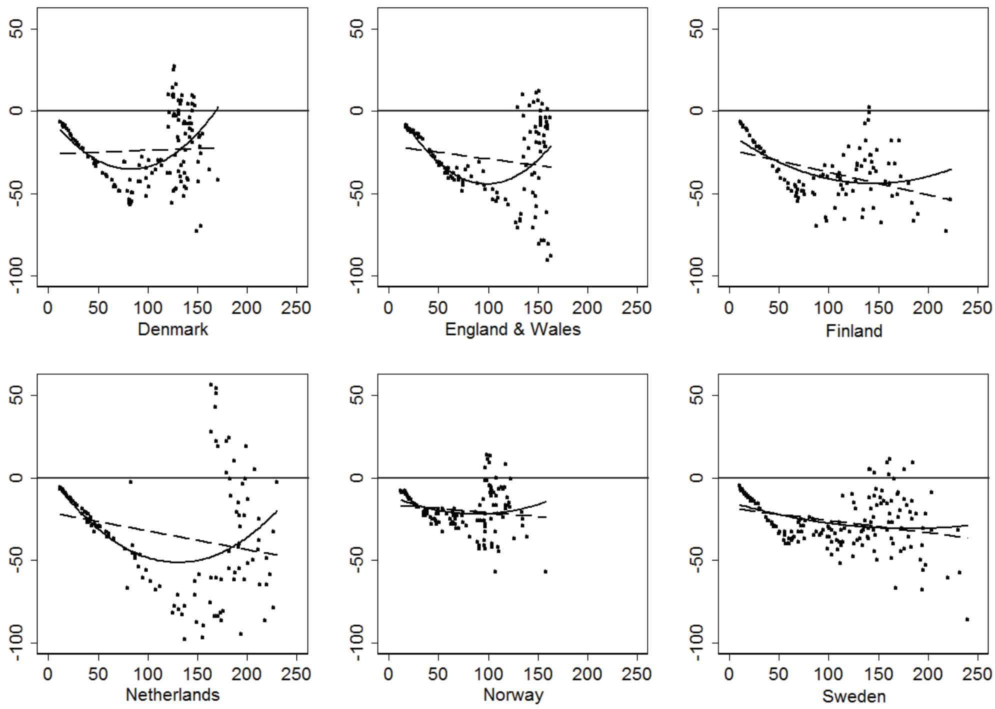

Figure 5: Absolute changes over 25 year periods against initial levels of infant mortality (deaths per 1,000 livebirths) and OLS regression lines for linear and square fit. See notes to figure 5.

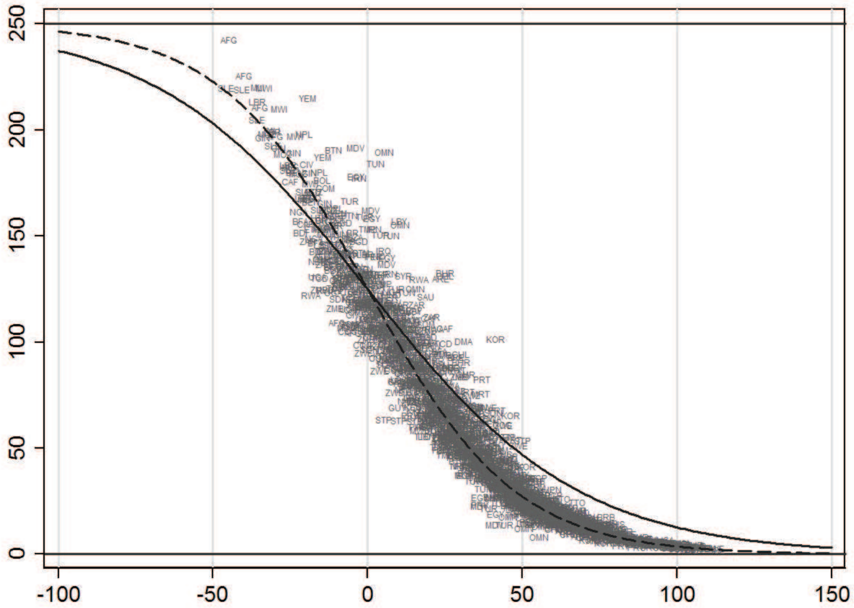

Figure 6: Infant mortality rates (per 1,000 livebirths), quinquennial observations for 192 countries between 1960–2010, against adjusted years and fitted transition path (corresponding to column (1) of table 3) for these observations (dashed line) and for the sample of industrialized countries (solid line, corresponding to column (4) of table 3). Based on WDI 2011 data and Mitchell [2003, pages 80–92], respectively.

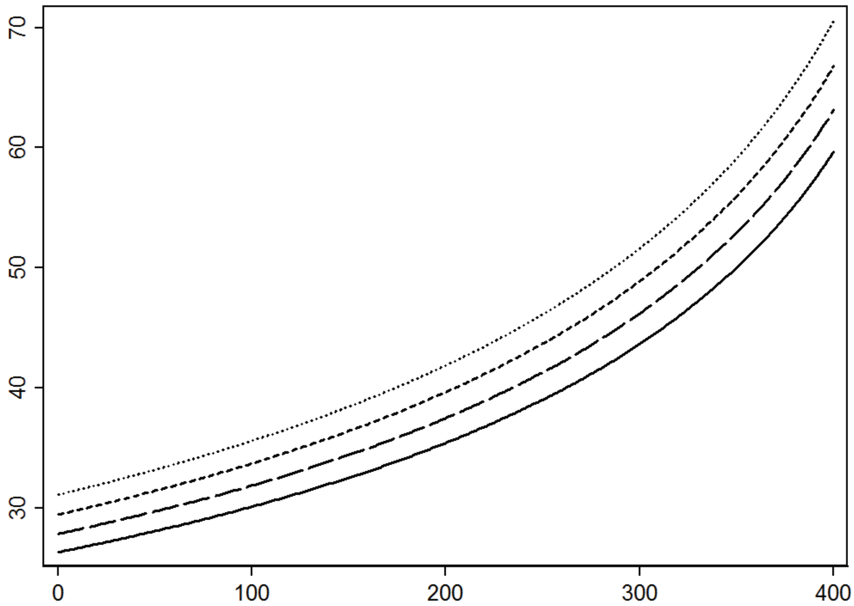

Figure 7: Estimated time to attain MDG4 (two-thirds reduction in under-five mortality) against initial level. The solid, long-dashed, short-dashed, and dotted lines correspond to columns (1), (2), (3), and (4) of table 2, respectively.

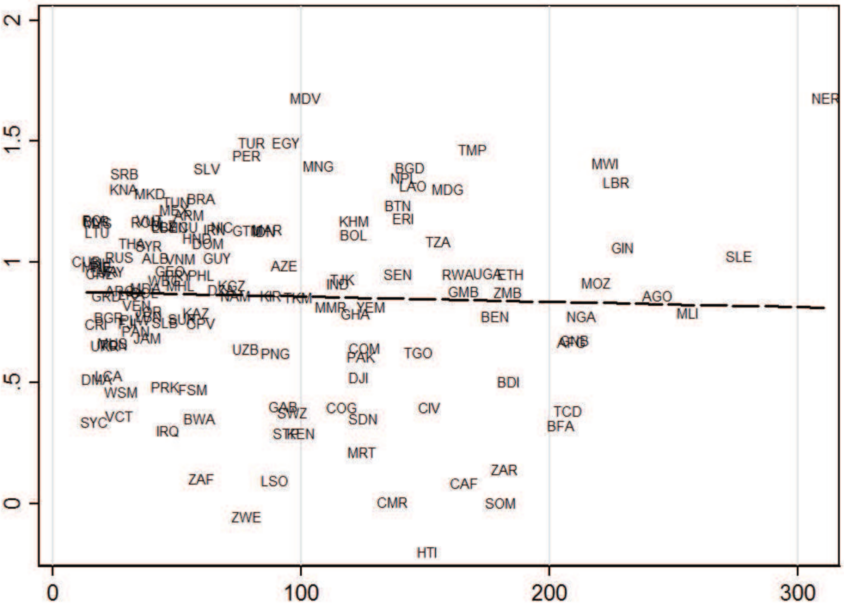

Figure 8: Performance index for under-five mortality, 1990-2010, against initial levels and fitted regression line, for 141 LICs & MICs, 1990–2010.

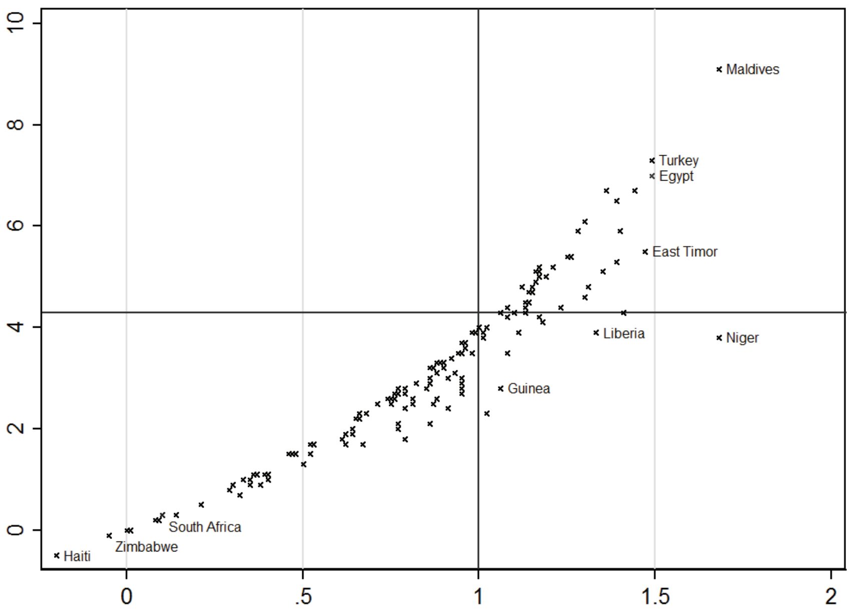

Figure 9: Annual rate of reduction (%) against performance index for under-five mortality for 141 LICs & MICs, 1990–2010. Countries classified as 'overperformers' are located to the right of the vertical line. Countries 'on-track' for a two-thirds reduction in under-five mortality are located above the horizontal line.

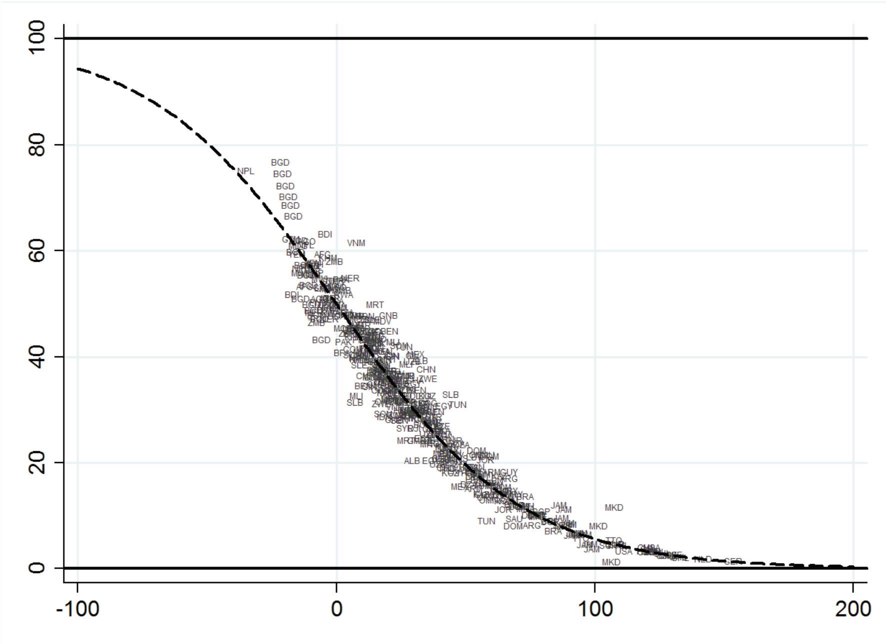

Figure 10: Proportion of children whose height-for-age is more than two standard deviations below the median for 114 countries between 1966–2009 against adjusted years and fitted transition path (corresponding to equation (15)). Based on WDI 2011 data.

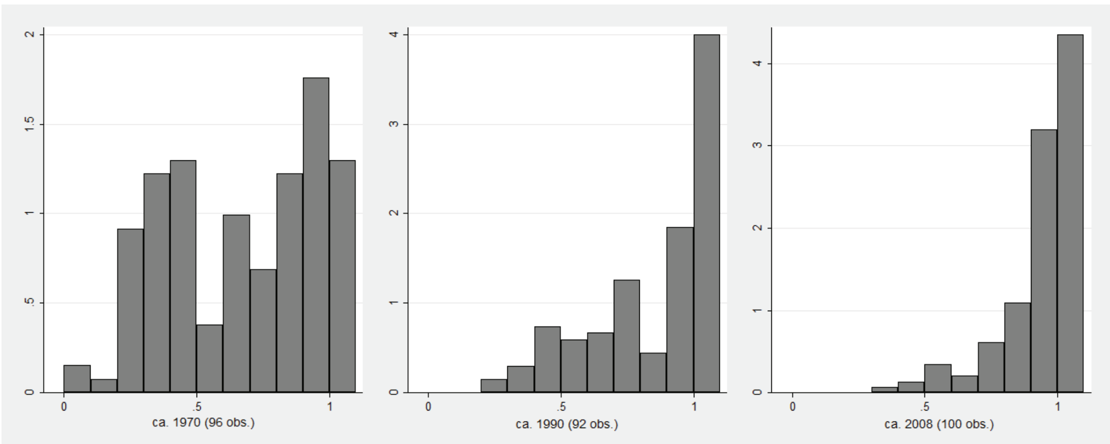

Figure 11: Histograms of the gender ratio in secondary education, 1970, 1990, and 2008 (or nearest observation). Based on WDI data.

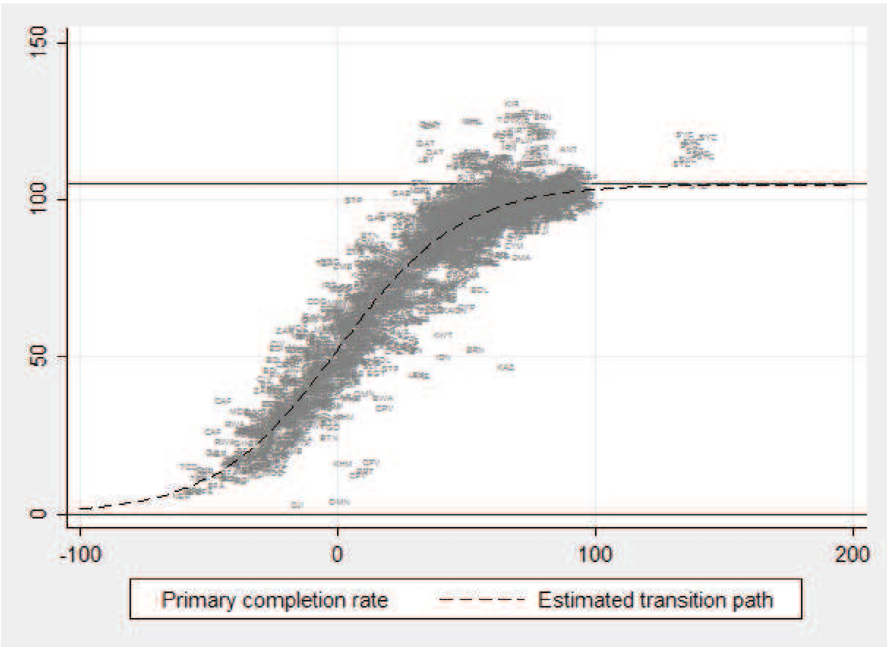

Figure 12: Primary completion rates, 1970–2009, against adjusted years and fitted transition path.

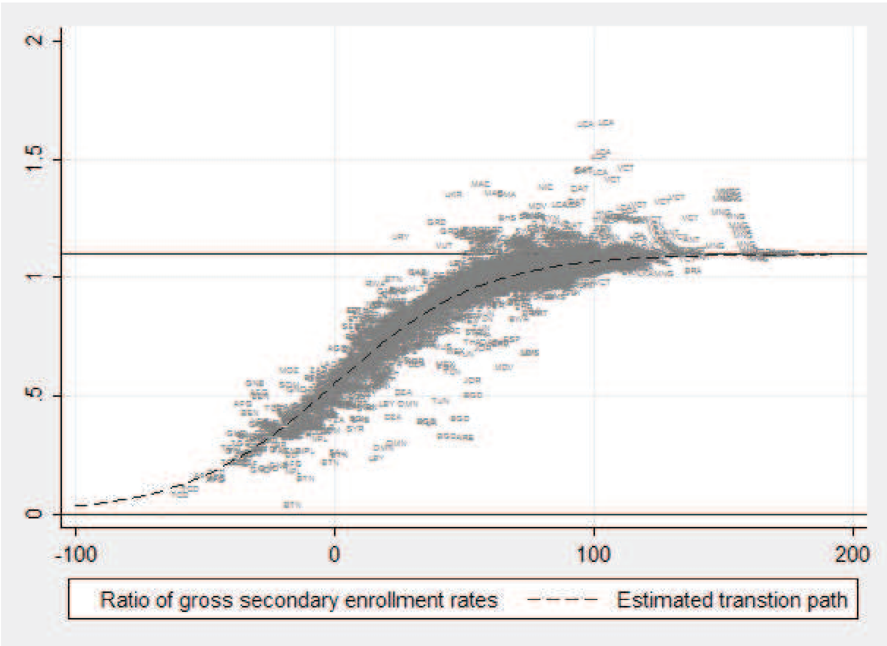

Figure 13: Ratio of male to female gross enrollment rate in secondary education, 1970–2009, against adjusted years and fitted transition path. (One observation for Nicaragua (1985) was dropped from the figure as it was larger than 2.)

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