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**Working Paper**

## Between-Country Disparities in MDGs: The Asia and Pacific Region

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## ADB Economics Working Paper Series



### Between-Country Disparities in MDGs: The Asia and Pacific Region

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Guanghua Wan and Yuan Zhang

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# **Between-Country Disparities in MDGs: The Asia and Pacific Region**

**Guanghua Wan and Yuan Zhang**

October 2011

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## **Abstract**

This paper explores disparities in Millennium Development Goals among countries in the Asia and Pacific region, with a special emphasis on health Millennium Development Goals. It provides estimates on the extent of these disparities and depicts their trends. More importantly, sources or causes of the disparities are quantified and policy implications are discussed.





## I. Introduction

Since their inception in 2000, the Millennium Development Goals (MDGs) have been set as the ultimate targets by the development community and national governments of developing countries. When MDG progress is discussed, however, attention has mostly been focused on average achievements implicitly or explicitly. For example, it is often stated that country or region A is performing better than B. Or the People's Republic of China (PRC) has done extremely well on poverty reduction. Such averages mask considerable variations across countries in a region, and across locations or population subgroups within countries. As a well-known example, Asia's performance on poverty reduction has been remarkable, but that does not mean the same for the Pacific island countries. In fact, Asia's average performance in all MDGs is largely driven by the PRC and India. By the same token, the average performance of a country does not mean the same for everyone. In most countries, urban areas generally achieve more than rural areas, and the affluent communities perform better than the poor.

The long-standing practice of focusing on the average while overlooking the distributional side of an economic variable has been increasingly called into question by the research community, and more importantly, by development practitioners and even policy makers (see Ravallion 2006, Wan 2008a and 2008b). This is especially evident by noting the shift of growth strategy in the past few decades from poverty reduction to pro-poor growth, and more recently to inclusive growth. While poverty reduction focuses exclusively on the bottom segment of a society, pro-poor growth still focuses on the poor, but not exclusively. Here, the welfare of the nonpoor enters the picture but only as a benchmark for comparisons with the poor. In comparison, inclusive growth assigns some weights to the welfare of the nonpoor and emphasizes the importance of gains to every member of the society. This brings to the fore some distributional or disparity issues.

To further highlight the significance and importance of the disparity issue, the following counterfactual can be conducted: what would it be like if disparities in income and other social economic outputs could be eliminated? Taking the first MDG indicator as an example, instead of still having 120 million abject poor in the PRC, poverty would disappear if income distribution were equal. In fact, abject poverty might have been almost eliminated in the PRC if income inequality did not rise in the past 25 years. For India, there were over 400 million people living under \$1.25/day (purchasing power parity [PPP]) in 2008, but they all would have stepped out of poverty if income had been distributed evenly. A substantial redistribution of income would also help cut down the

number of poor in India, even holding its gross domestic product (GDP) and national wealth constant.

Why are between-country disparities in MDGs worth research attention? First, large cross-country gaps in social development outcomes as represented by MDGs are not acceptable on ethical grounds. For example, there is no justification whatsoever for poor countries to suffer frequent starvation while others overconsume food and have to deal with obesity. Second, cross-country disparities along income and nonincome dimensions constitute the root cause of some of cross-border crimes such as illegal migration, prostitution, and human trafficking. Third, severe heterogeneity in Asia in terms of MDG levels is believed to be detrimental to regional integration, which could otherwise benefit all countries in the region and beyond. Fourth, lagging MDGs particularly in education and health indicators in poorly performing countries imply loss or waste of potential human resources that could be utilized to improve the welfare of the poor countries, their neighbors, and their trading partners. Finally, the possible link between disparity and civil unrest or even wars does not only affect the country in question but also could produce spillover effects and have far reaching security/stability implications for other countries. In passing, it is worth mentioning that all the justifications underlying income inequality studies are applicable here. To a large extent, MDG disparities could be more important, because income can be viewed as the means, while many of the MDGs represent the ends.

It is thus not surprising that at the September 2010 MDG Summit in New York, the issue of MDG disparities was unanimously highlighted by Under-Secretary Generals of the United Nations from all regions, including the Asia and Pacific region. Yet, little analytical research has been undertaken on MDG disparities anywhere. Even the degree or extent of disparity in MDGs is largely unknown despite frequent acknowledgement and discussions of its existence, let alone causes or possible remedies of these disparities. This is regrettable, as achieving MDGs requires not only improvements in the average levels of MDGs, but also, and perhaps more importantly, improvements in the distributional aspect of MDGs. This is particularly applicable to Asia as inequality in Asia has been fast growing despite remarkable economic growth over the last several decades.

The focus of this paper is on MDG disparities in the Asia and Pacific region, with a special emphasis on health MDGs. To be more specific, the paper aims at (i) constructing profiles of MDG disparities in Asia and the Pacific region, which helps identify the symptoms of the MDG challenge; (ii) exploring sources of MDG disparities in Asia and the Pacific, to provide diagnoses on the problem of MDG disparities while taking into account policy and nonpolicy drivers of (in)equitable MDG distribution; and (iii) making relevant policy recommendations to offer prescriptions based on the diagnosis.

In addition to analyzing individual MDG disparities, efforts will be made to explore interactions among different MDGs by addressing questions such as: how is fast-rising inequality in income or GDP related to MDG disparities? Did improvements in water or sanitation help narrow down disparities in health MDGs? Also, hunger is found to be persistent at least in South Asia despite significant economic growth. Thus, it would be useful to examine to what extent income is delinked with nonincome poverty such as malnutrition.

## II. Data and Methodological Issues

The primary source of data on MDGs is the Global MDG database. For observations on variables that could account for disparities, various avenues will be explored, including but not limited to, the *Asian Development Outlook* and *Key Indicators for Asia and the Pacific* of the Asian Development Bank, World Development Indicators of the World Bank, different yearbooks of individual countries, and so on. To maintain compatibility and consistency of data across countries and over time, observations in monetary terms will be deflated by country consumer price indexes (CPIs) and converted into common dollar amounts using PPPs compiled under the International Comparison Program (ICP). These PPPs are constructed as multilateral price indexes using directly observed consumer prices in many countries.

Among the eight MDGs with a total of 60 indicators, little numerical information exists for Goal 8, which has 16 indicators. For the remaining seven MDGs with 44 indicators, there are large variations in data availability in terms of the number of countries covered for any year or number of years covered for any country. For many indicators, data are limited to no more than several reported observations for any particular year, rendering disparity analysis infeasible. Consequently, only 25 MDG indicators (listed in Table 1) can be considered in this study. Even for these indicators, only a couple of years can be included in the study as there are too many missing values for most years.

**Table 1: Data Points Used in the Study**

MDG Goal	Goal 1: Eradicate extreme poverty and hunger	Goal 2: Achieve universal primary education	Goal 3: Promote gender equality and empower women	Goal 4: Reduce child mortality	Goal 5: Improve maternal health							
Indicators	\$1.25 per day poverty	Primary enrollment	Reaching last grade	Primary completion	Gender primary	Gender secondary	Gender tertiary	Under-5 mortality	Infant mortality	Maternal mortality	Skilled birth attendance	Antenatal care
Number of reported observations	5, 14, 7	12, 14, 12	22, 26, 26	17, 20, 20	29, 28, 24	37, 39, 30	33, 38, 24	23, 32, 21	46, 47, 47, 47	37, 37, 37, 37	14, 15, 13	12, 17, 12
Number of imputed values	20, 19, 22	6, 10, 10	5, 3, 5	4, 5, 6	4, 5, 10	4, 5, 9	2, 5, 11	4, 2, 7	1, 0, 0, 0, 0	0, 0, 0, 0	20, 21, 16	8, 6, 13
Years to be covered	1997, 2002, 2004	1995, 2000, 2005	1999, 2001, 2007	1999, 2003, 2007	1999, 2003, 2008	1999, 2003, 2008	1999, 2003, 2008	1999, 2003, 2008	1990, 1996, 2002, 2009	1990, 1995, 2000, 2008	1997, 2001, 2007	1997, 2000, 2007

MDG Goal	Goal 6: Combat HIV/AIDS, malaria and other diseases	Goal 7: Ensure environmental sustainability										
Indicators	HIV prevalence	TB incidence	TB prevalence	Forest cover	CO <sub>2</sub> emissions	Protected area	Safe drinking water	Water, urban	Water, rural	Basic sanitation	Sanitation, urban	Sanitation, rural
Number of reported observations	30, 30	54, 53, 55, 55	55, 55, 55, 55	51, 51, 51	40, 49, 51, 51	52, 52, 52, 52	37, 46, 48, 40	42, 47, 49, 45	36, 45, 47, 39	35, 46, 48, 41	40, 47, 49, 44	34, 45, 7, 41
Number of imputed values	0, 0	0, 1, 0, 0	0, 0, 0, 0	0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0	0, 0, 0, 0
Years to be covered	2001, 2007	1990, 1996, 2002, 2008	1990, 1996, 2002, 2008	1990, 2000, 2005	1990, 1996, 2002, 2007	1990, 1996, 2002, 2009	1990, 1995, 2000, 2008	1990, 1995, 2000, 2008	1990, 1995, 2000, 2008	1990, 1995, 2000, 2008	1990, 1995, 2000, 2008	1990, 1995, 2000, 2008

Source: Authors' compilation.

To expand data coverage, it was decided to use imputed values that are adjacent to a reported observation. From Table 1, it is clear that for Goals 4, 6 and 7, almost all data are actually reported observations. However, for Goals 1 and 5 (except maternal mortality), substantial proportions of data points are imputed values. Moderate proportions of imputed values are used for the other MDGs in Table 1. In deciding which year to include in the study, the guiding principle is to have at least 70% or more of the regional population covered when actually reported and imputed observations are combined. Thus, to the extent possible, data representativeness is carefully considered.

Given observations on MDGs for a particular year, disparities can be inspected simply by graphic means or measured formally by computing inequality indices.<sup>1</sup> The oldest and most popular index is the Gini coefficient. However, in this paper the so-called Theil-L index (Theil 1967) will also be used to describe MDG disparities and, when possible, to show change(s) in the disparity. Other well-known disparity measures will not be used, which is acceptable because results of alternative inequality measures are highly correlated (Shorrocks and Wan 2005). The Theil-L index is used here because it allows decomposition of total regional inequality into components associated with subregions or subgroups of countries (Theil 1972), as discussed in Section IV below.

Once inequalities are measured, attention will be turned to identification of determinants of the disparities. The conventional approach is to classify countries into several groups according to a variable such as per capita GDP (PPP-adjusted) and then work out how much of the disparity can be attributed to gaps between countries within groups, and how much between these groups. It is also possible to classify countries into subregions and find out how much of the total disparity is attributed to gaps between countries within subregions, and how much between subregions. Following Cowell and Jenkins (1995), the proportion of the between component is attributed to the variable that is used to classify countries.

A better approach to exploring sources of disparity is the regression-based inequality decomposition (Wan 2002 and 2004, Wan et al. 2007). Under this framework, the first step is to construct an MDG model linking the MDG with its determinants including macroeconomic variables such as income, education level, urbanization and so on. This model is useful in identifying what policy instruments are important for improving the level of MDGs. It can also be employed to decompose MDG disparities, attributing total disparity to the relevant contributors. The decomposition will offer insights as to how much MDG disparity will be reduced if differences in spending, in schooling, in governance, and so on can be eliminated.

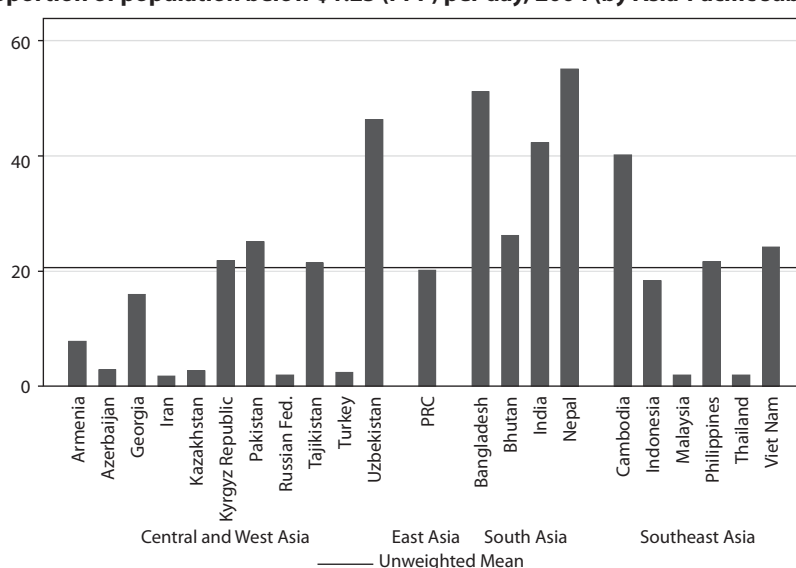
<sup>1</sup> Although MDGs are usually assessed in terms of a country's progress toward its targets, disparities will be measured in terms of MDG values, not its progress. Taking poverty reduction as an example, suppose country A has overachieved this goal by lowering the poverty head count ratio from 0.6 to 0.1, and country B just achieved the goal by lowering the ratio from 0.4 to 0.2. Thus, the disparity measured in terms of the MDG progress is nil as both countries recorded 100% achievement. But disparity in terms of poverty headcount ratio still exists, and it is this disparity that will be analyzed in this paper. This makes sense as completely eliminating poverty is the ultimate overarching objective of development while the progress is only meaningful when the deadline of 2015 is considered.

### III. MDG Disparities: Preliminary Data Analyses

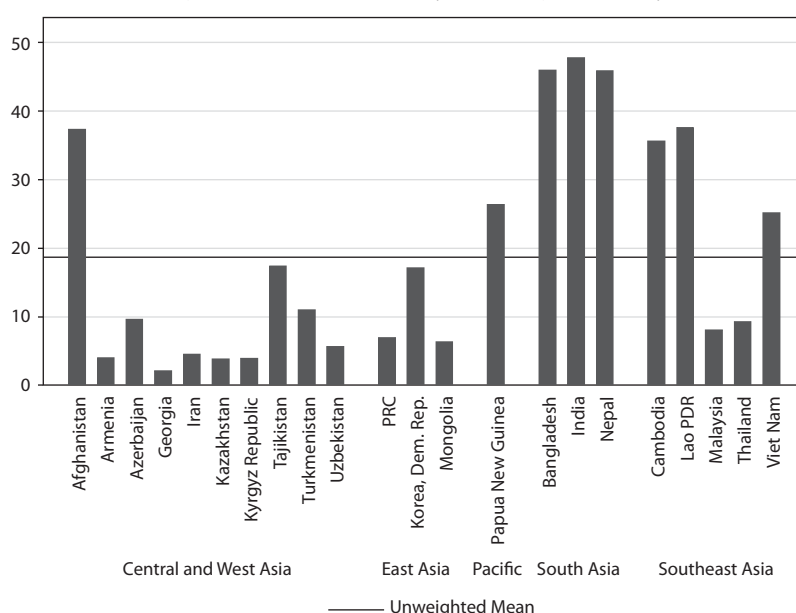
A simple way to illustrate gaps in MDGs between countries is to show differences between individual country observations and the regional mean. In this paper, the unweighted mean is used so that smaller countries are not being discriminated. In other words, the same percentage drop in poverty or improvement in access to sanitation is as important for the Republic of Fiji as for the PRC, although the number of people affected greatly differs in these two countries. Figure 1 plots MDG values for the latest year when data have good coverage of countries.

#### Goal 1: Eradicate Extreme Poverty and Hunger (percent)

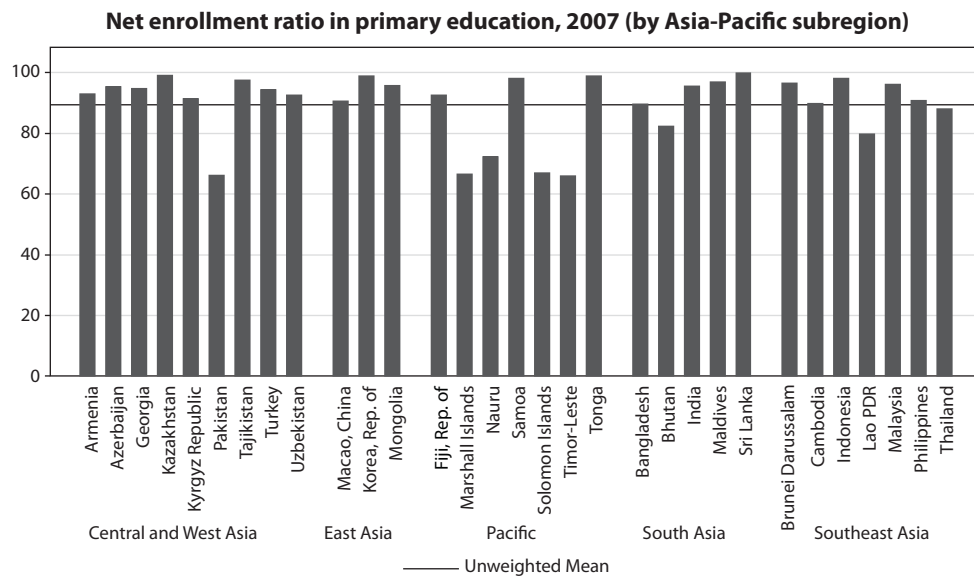
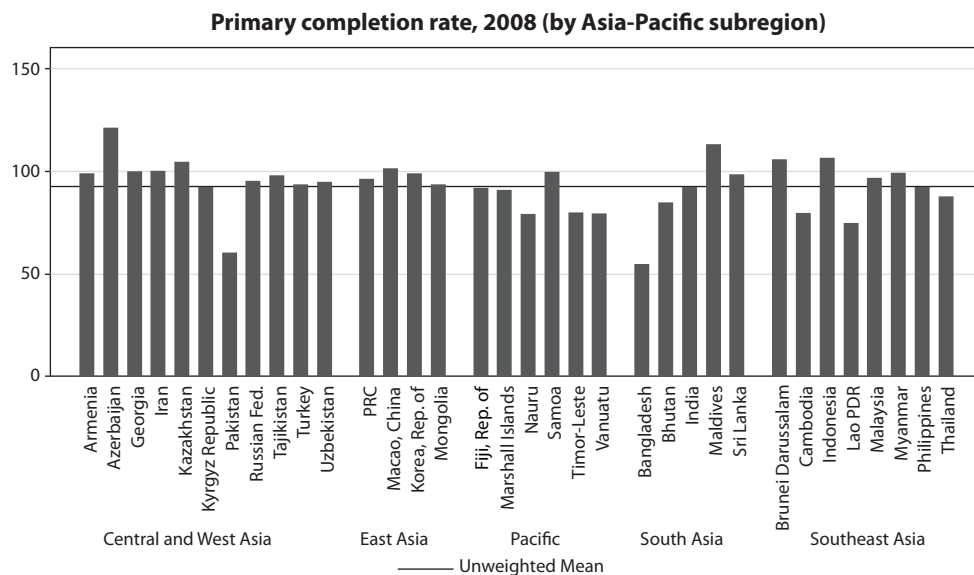
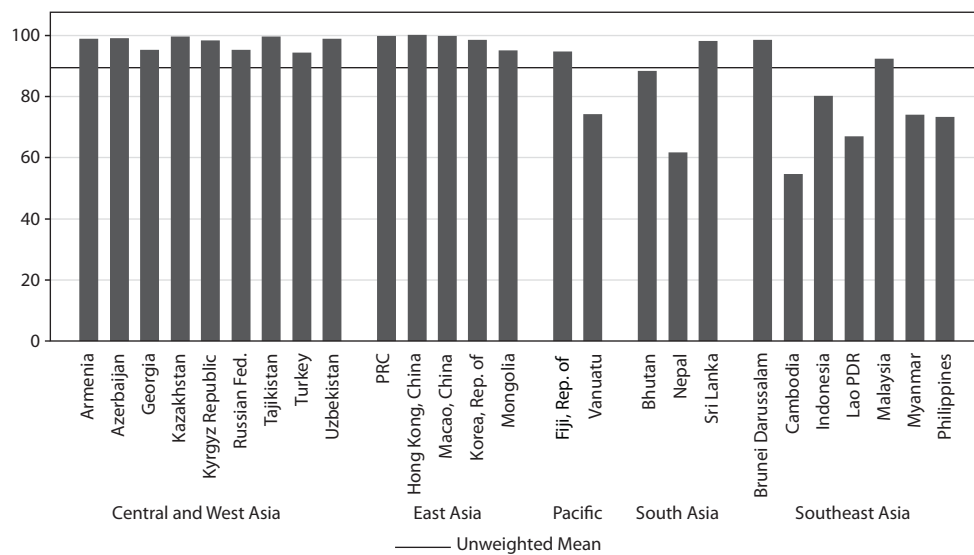
Proportion of population below \$1.25 (PPP) per day, 2004 (by Asia-Pacific subregion)



Prevalence of underweight children under-five years of age, 2005 (by Asia-Pacific subregion)

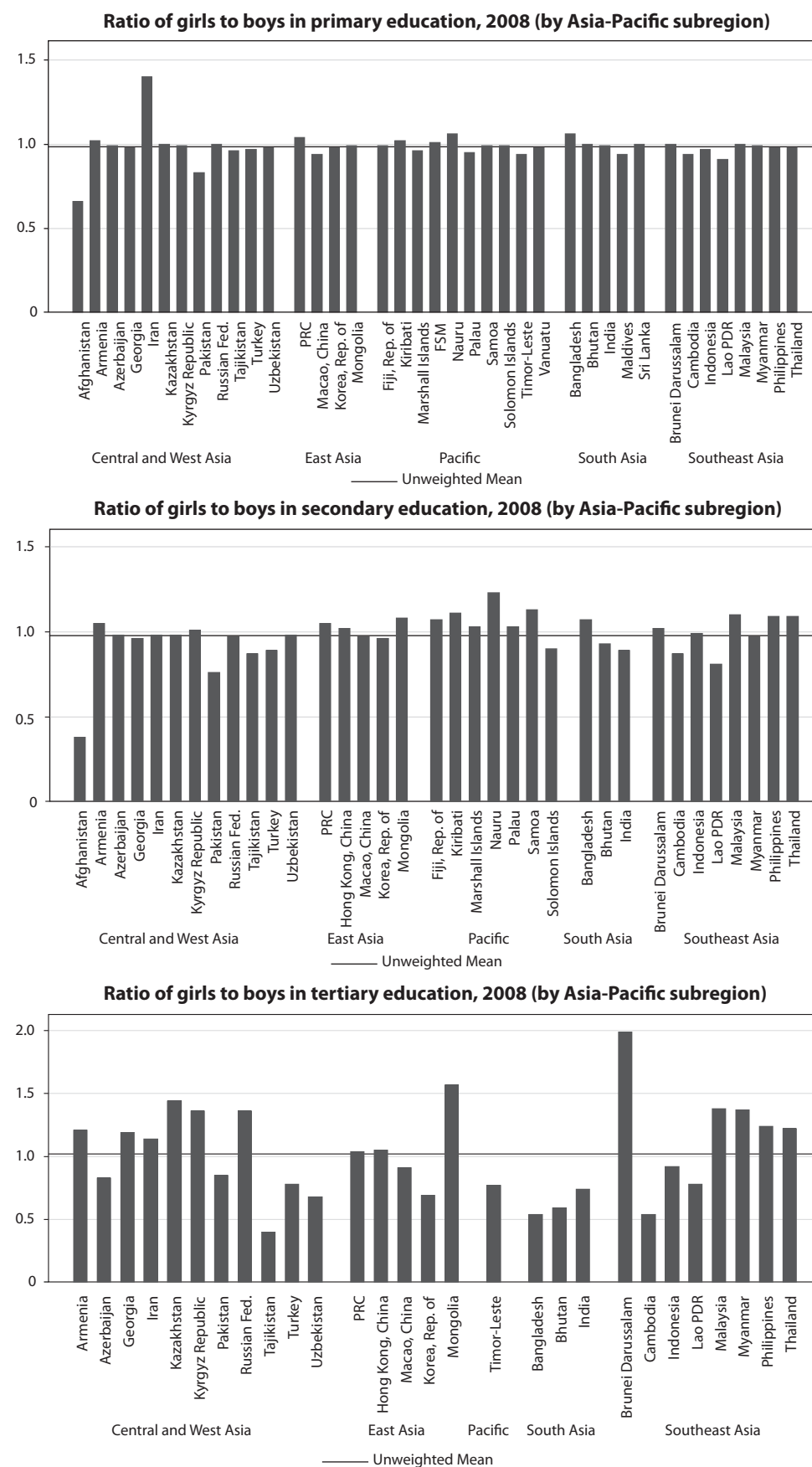


Source: Authors' compilation.

**Goal 2: Achieve Universal Primary Education (percent)****Proportion of pupils starting grade 1 who reach last grade of primary, 2007 (by Asia-Pacific subregion)**

Source: Authors' compilation.

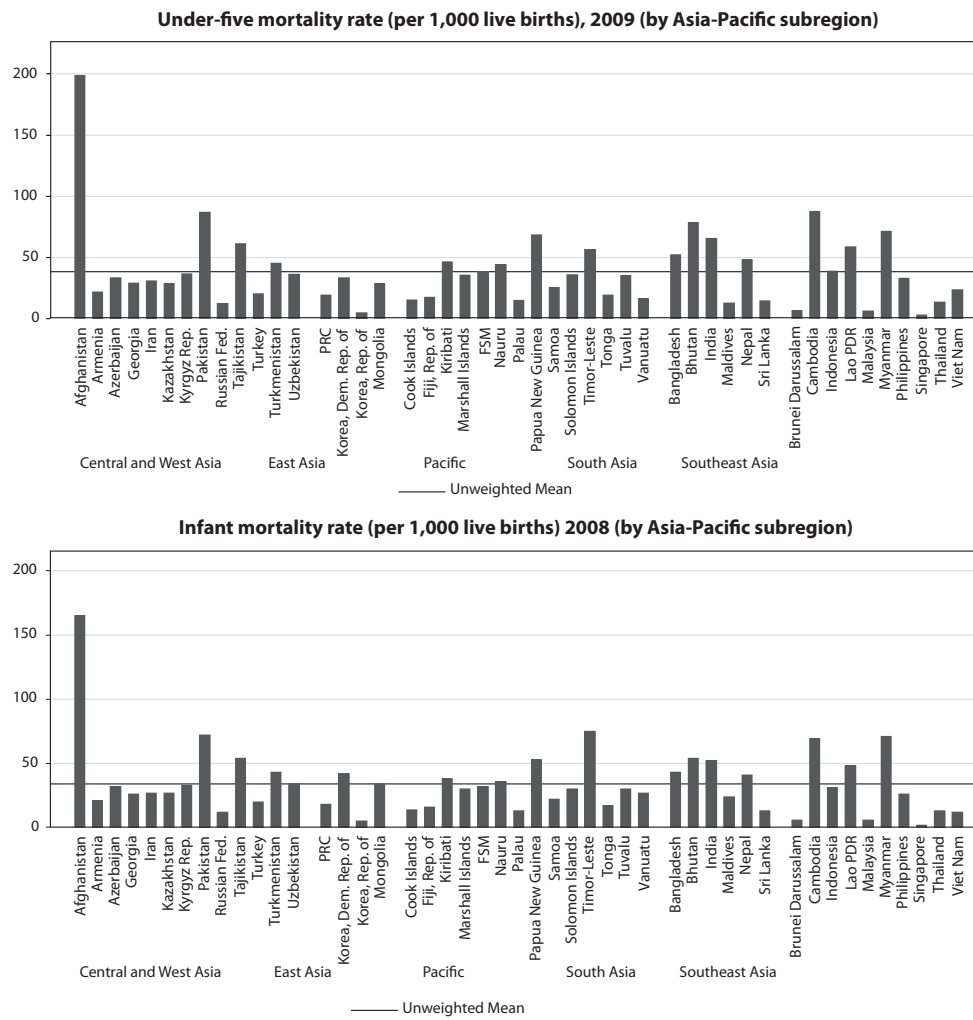


**Goal 3: Promote Gender Equality and Empower Women**

FSM = Federated States of Micronesia, PRC = People's Republic of China.

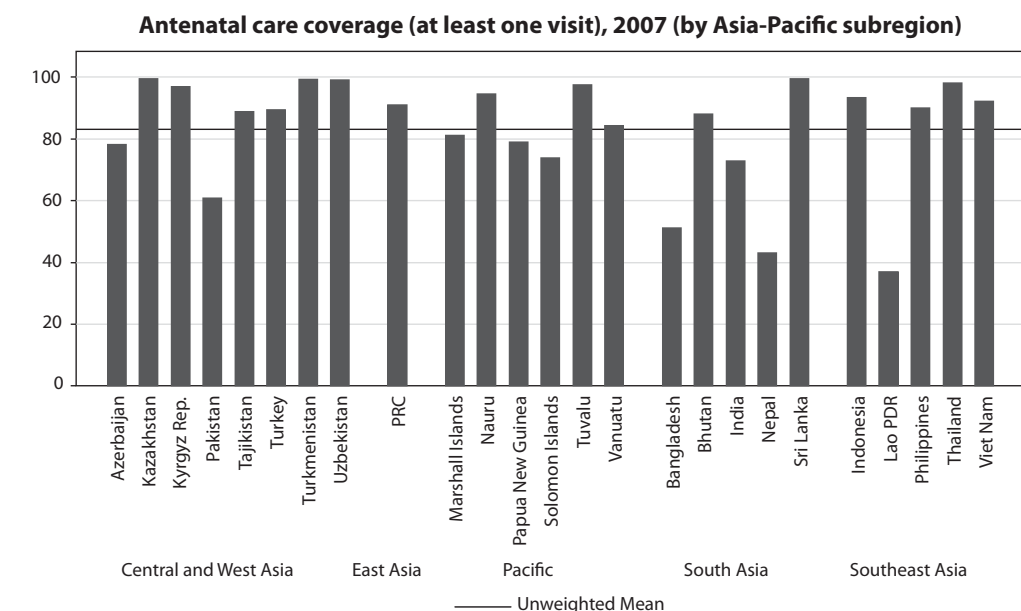
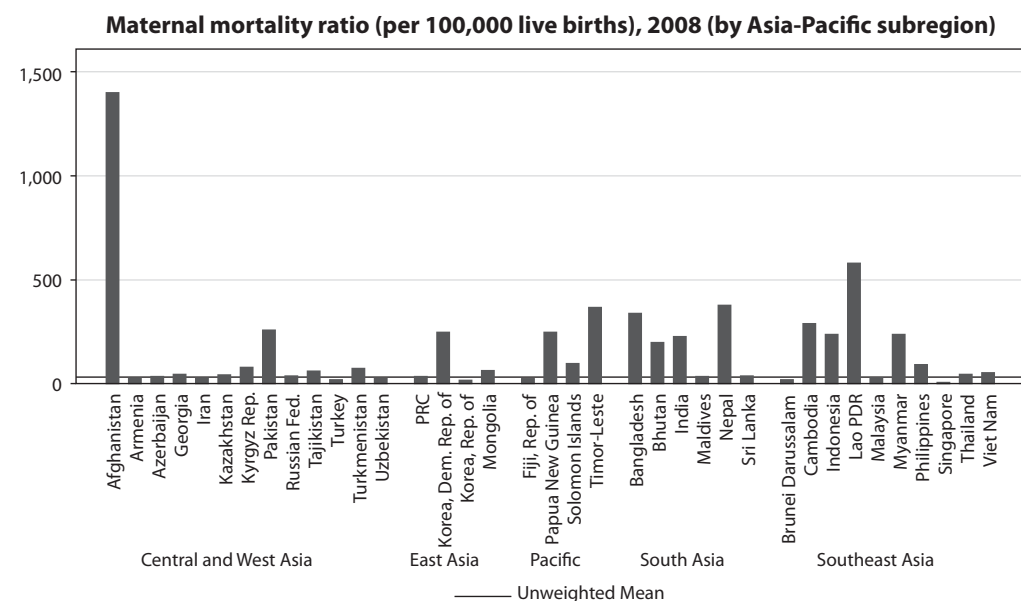
Source: Authors' compilation.

## Goal 4: Reduce Child Mortality

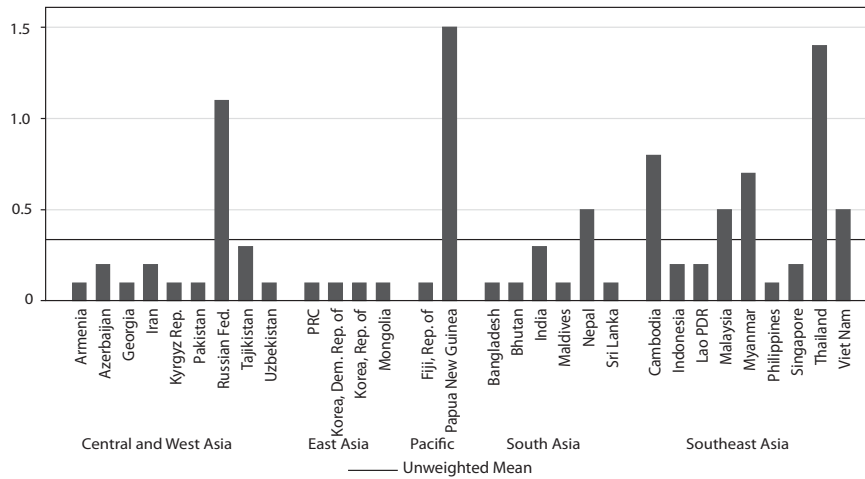
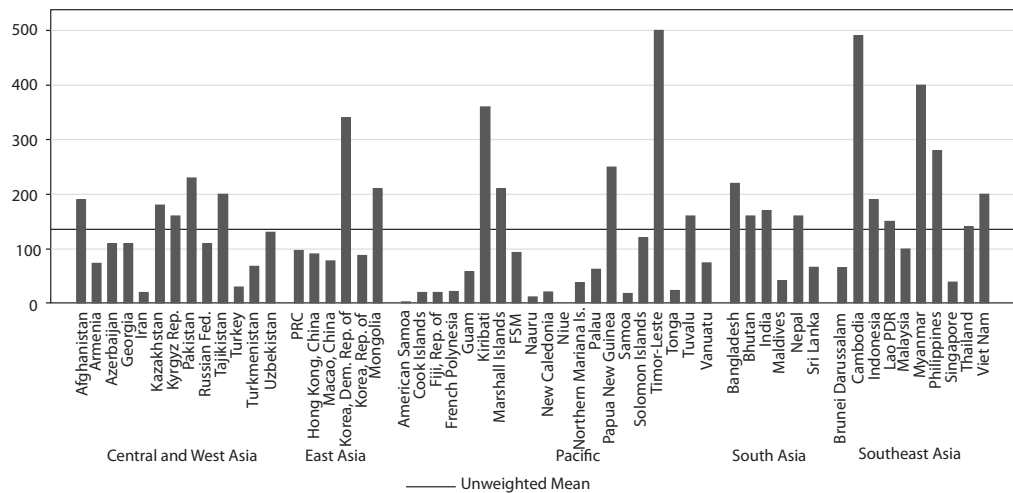
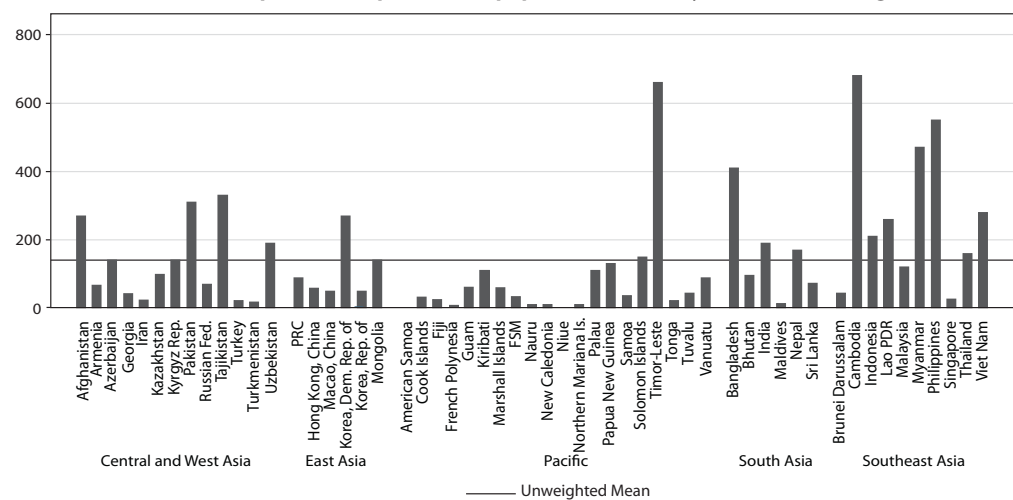


FSM = Federated States of Micronesia, PRC = People's Republic of China.

Source: Authors' compilation.

**Goal 5: Improve Maternal Health**

Source: Authors' compilation.

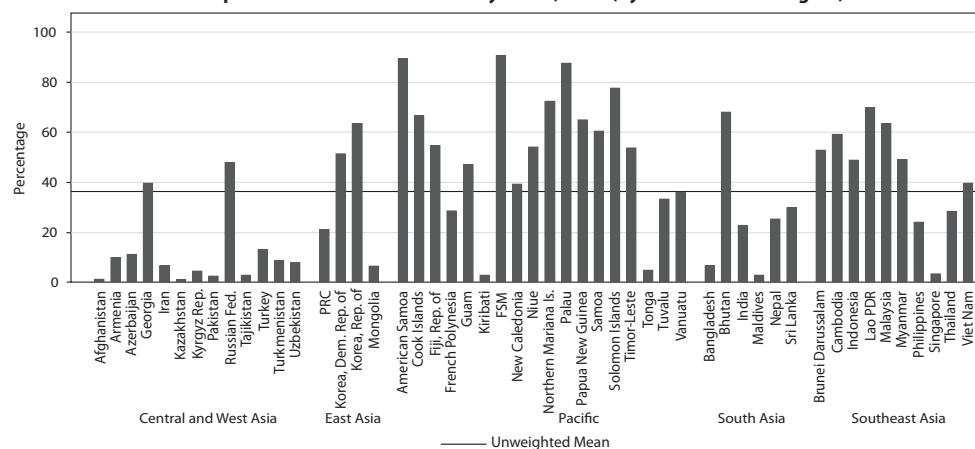
**Goal 6: Combat HIV/AIDS, Malaria and Other Diseases****HIV prevalence among population 15–24 years, 2007 (by Asia-Pacific subregion)****Tuberculosis incidence (per 100,000 population), 2008 (by Asia-Pacific subregion)****Tuberculosis prevalence (per 100,000 population), 2008 (by Asia-Pacific subregion)**

FSM = Federated States of Micronesia, PRC = People's Republic of China.

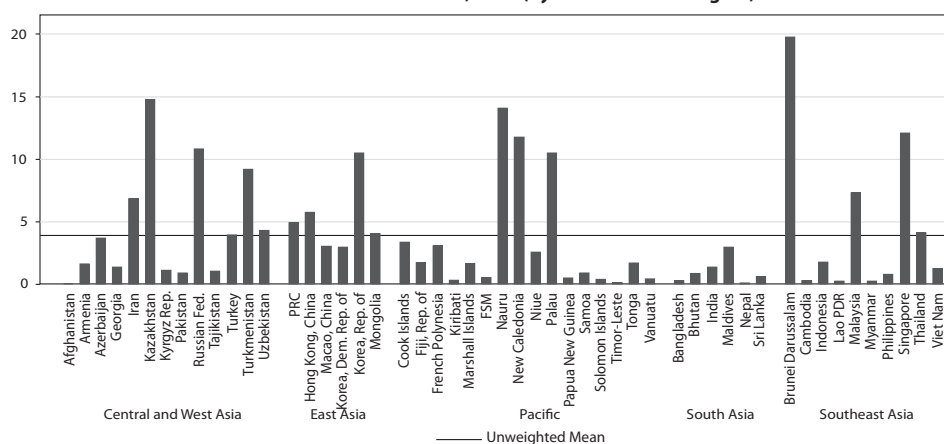
Source: Authors' compilation.

## Goal 7: Ensure Environmental Sustainability

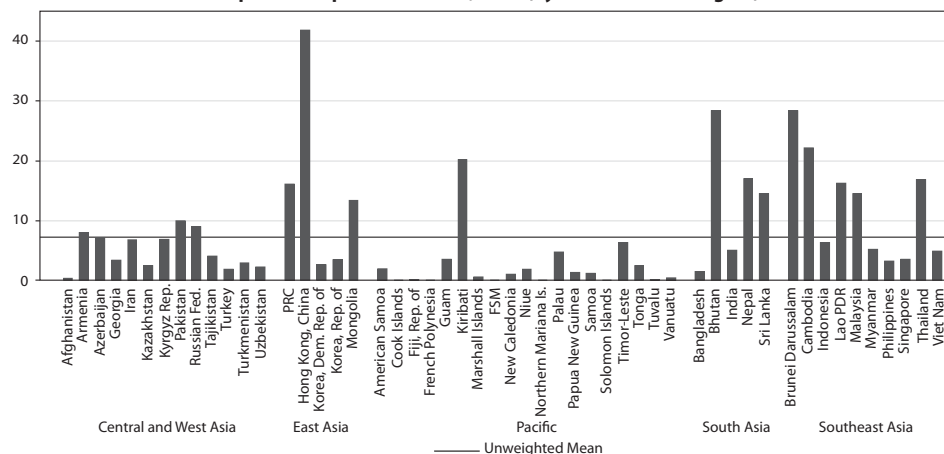
Proportion of land area covered by forest, 2005 (by Asia-Pacific subregion)



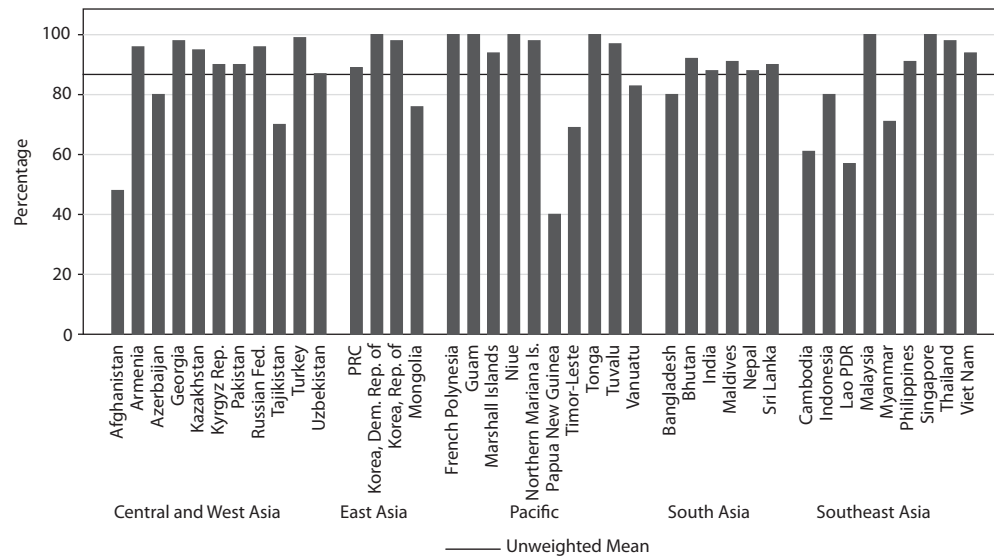
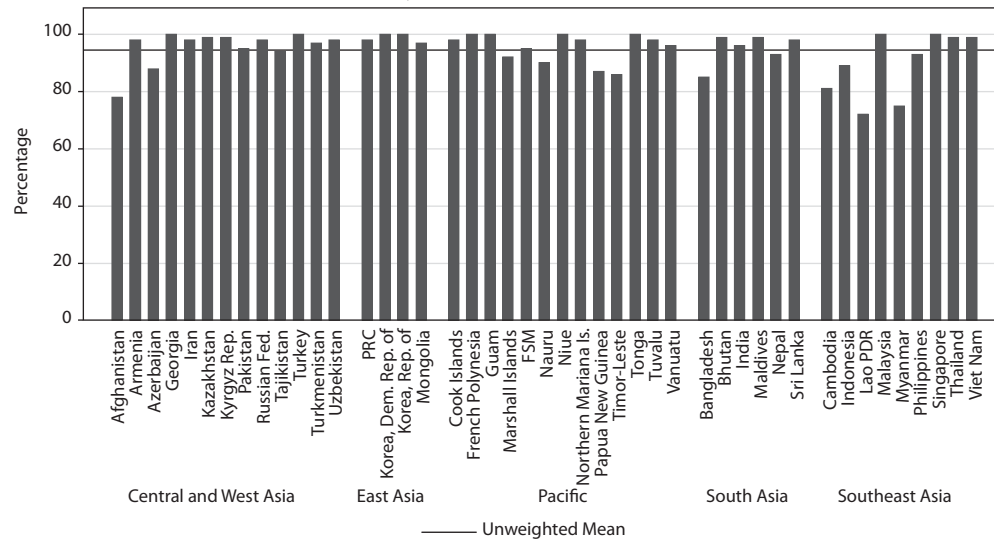
Carbon dioxide emissions, 2007 (by Asia-Pacific subregion)



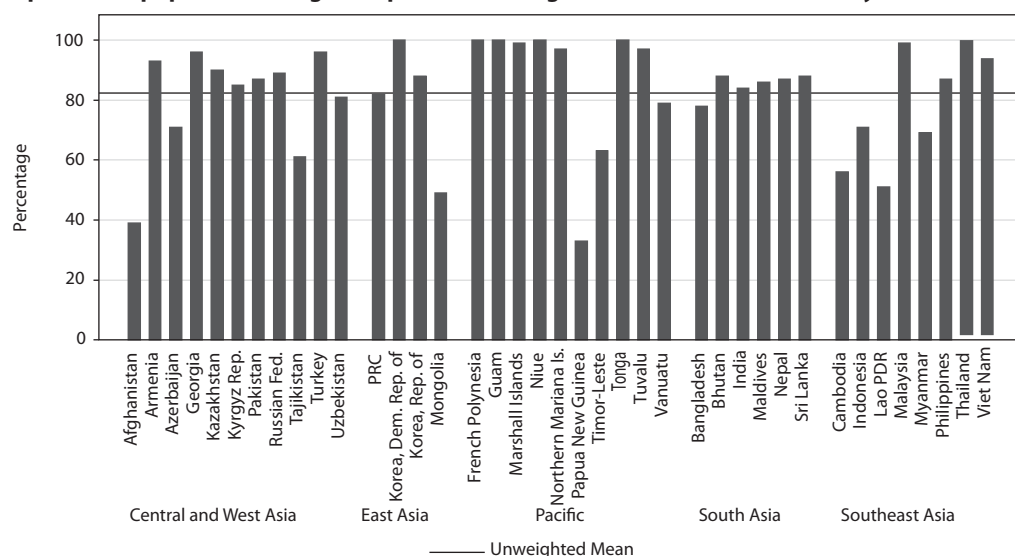
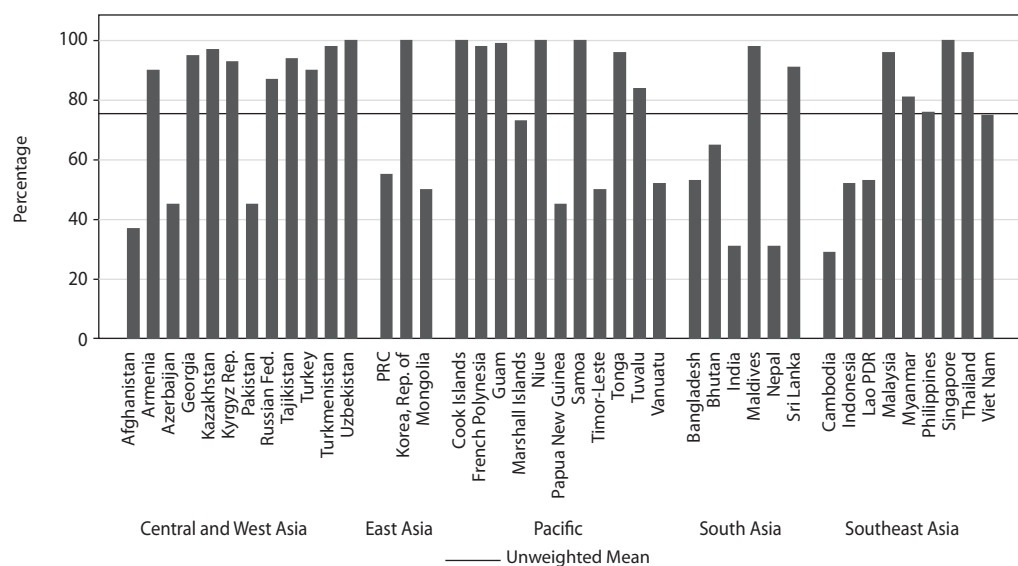
Proportion of protected areas, 2009 (by Asia-Pacific subregion)



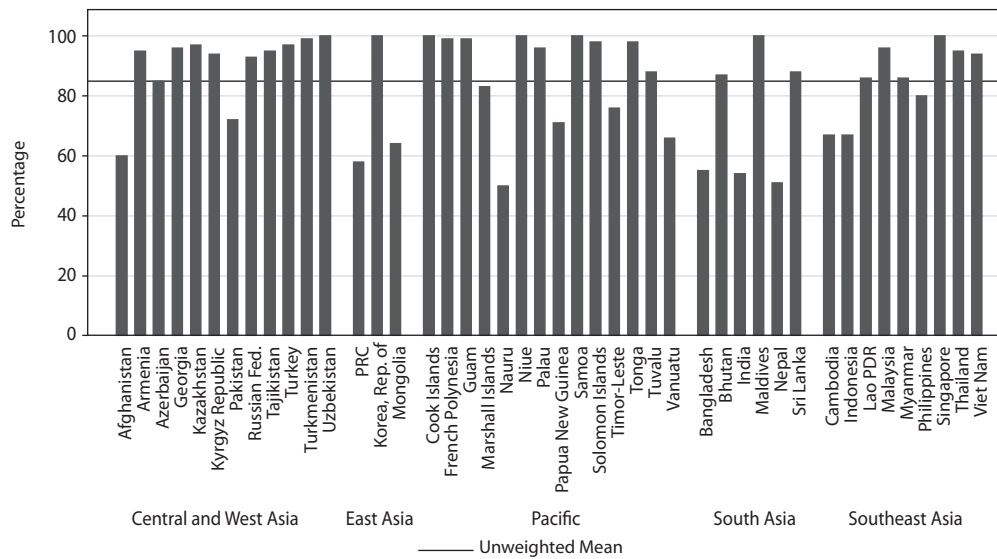
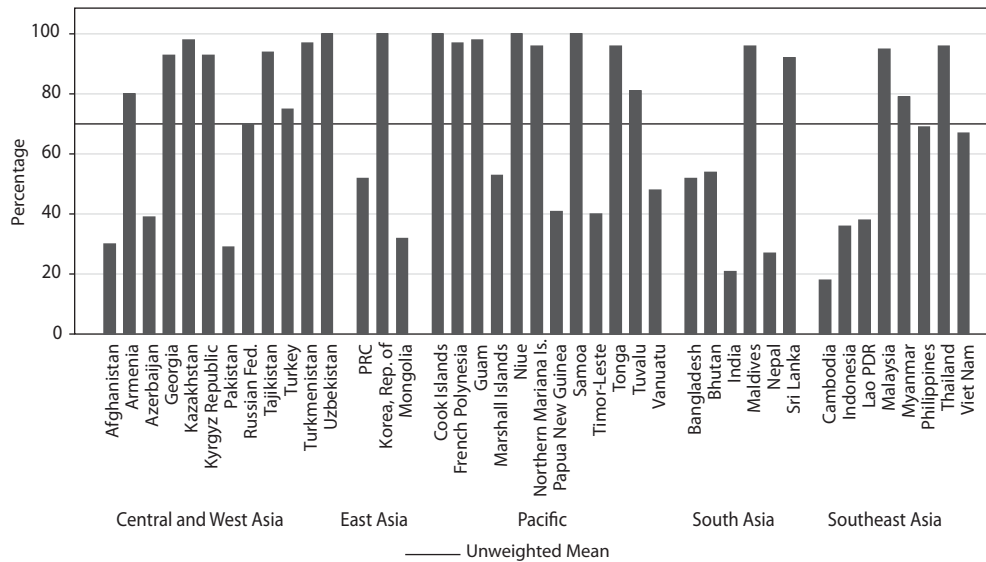
continued.

**Goal 7: continued.****Proportion of population using an improved drinking water source, 2008 (by Asia-Pacific subregion)****Proportion of population using an improved drinking water source (urban), 2008 (by Asia-Pacific subregion)**

continued.

**Goal 7: continued.****Proportion of population using an improved drinking water source (rural), 2008 (by Asia-Pacific subregion)****Proportion of population using an improved sanitation facility, 2008 (by Asia-Pacific subregion)**

continued.

**Goal 7: continued.****Proportion of population using an improved sanitation facility (urban), 2008 (by Asia-Pacific subregion)****Proportion of population using an improved sanitation facility (rural), 2008 (by Asia-Pacific subregion)**

FSM = Federated States of Micronesia, PRC = People's Republic of China.

Source: Authors' compilation.



Clearly, disparities in MDGs are quite significant, as expected. As far as poverty headcount ratio in 2004 is concerned, good performers included Malaysia, Thailand, and several Central Asia economies, while Uzbekistan and most South Asian countries were laggards. Those close to the average were the PRC, the Kyrgyz Republic, the Philippines, and Tajikistan. The picture on underweight children resembles that of poverty but the latter seems to be slightly more homogeneous. Here, Central and West Asia performed rather well, more or less matching East Asia.

Turning to Goal 2, all three indicators show high level of achievement. In terms of disparity, net primary enrollment ratio varied a little across countries, but it is difficult to see which of the three indicators has the smallest or largest inequality. This is the major deficiency of the visual approach, which calls for more formal inequality measurement. Regarding gender equality indicated by the girl–boy ratio in educational institutions (Goal 3), across-country gaps are negligible in primary schools, with Afghanistan as the major exception. The gaps become visible when it comes to secondary school and is quite large in tertiary education. Overall, inequality appears less severe in Goals 2 and 3 than in other MDGs.

Health-related MDGs (Goals 4–6) are the focus of this paper. It appears that the three indicators under Goal 6 (HIV prevalence, tuberculosis [TB] incidence, and prevalence) exhibit significant disparities. On the other hand, antenatal care coverage and professional birth attendance show relatively small variations across countries. Child-related MDGs (under-five mortality rate and infant mortality rate) display moderate inequality. It seems maternal mortality is associated with large cross-country gaps but the visual effects are not so clear.

Among the nine indicators of the environmental MDG, six are related to water and sanitation and they appear to be more homogeneous than the other three. There appear to be large gaps in terms of carbon dioxide emissions and forestry coverage although protected areas also show significant variations across countries. Turning to water and sanitation, the urban sector is more homogenous than the rural counterpart and the gaps in sanitation are larger than those in safe drinking water for rural or urban sector. In fact, there is little variation in access to safe drinking water for urban residents. Generally speaking, water and sanitation inequalities seem less serious than those associated with health-related MDGs.

The above findings are more or less consistent with those based on the squared coefficients of variation ( $CV^2$ )—a modified conventional statistical measure of dispersion.<sup>2</sup> However, it must be pointed out that  $CV^2$  as a disparity measure violates the crucial transfer principle, thus is not commonly used (Wan 2006). Nevertheless, unlike the plots,

<sup>2</sup>  $CV^2$  is related to the family of generalized entropy measures (Theil 1972) can thus be considered as an inequality indicator. There is no justification for the use of CV in distributional studies, thus CV never appears in the inequality literature.

the  $CV^2$  is a unit-free summary indicator, which allows comparison of disparities for different MDGs.

Table 2 tabulates estimates of  $CV^2$  for the 25 MDG indicators. It is clear that MDG 2 is most homogeneous with  $CV^2$  ranging from 0.01 to 0.02. MDG 3 is also quite evenly distributed if the indicator of gender equality in tertiary education is not considered. Next come the water and sanitation MDG indicators with  $CV^2$  ranging from 0.01 to 0.16. The remaining environmental MDG indicators have some of the largest inequalities. Both MDGs 1 and 4 are associated with similar and moderate disparities.

Apart from antenatal care and skilled birth attendance, health-related MDGs show quite large variations across countries. In particular, the maternal mortality indicator has a  $CV^2$  of 2.27, the largest among all the 25 MDG indicators under study. This finding is important because maternal mortality is the MDG target that is farthest from being achieved by most countries. The lack of progress in maternal mortality underlies the Muskoka Initiative of G20, which pledges \$7.3 billion for improving maternal, newborn, and child health over the period 2010–2015. The lagging of health-related MDGs also prompted the swift action of the United Nations at the conclusion of its 2010 MDG Summit, securing \$40 billion for women's and children's health. Interestingly, our research reveals that health-related MDGs are not only most lagging but also most unevenly distributed in Asia and possibly in other regions, offering additional justifications for prioritizing health-related MDGs.

A formal tool for analyzing disparity profiles is the Lorenz curve (Lorenz 1905). By definition, the curve always lies below the diagonal line: the further away from the diagonal line, the higher the inequality. Figure 2 provides the Lorenz curves for the 25 MDG indicators. The most striking finding is that the Lorenz curves for MDGs 2 and 3 and safe drinking water are very close to the diagonal line, thus between-country disparities are not a serious issue as far as these MDG indicators are concerned. Note that even for gender equality in tertiary institutions the curves are not far from the diagonal line, indicating mild disparity. The same can be said with regard to skilled birth attendance, antenatal care and basic sanitation.

Table 2: MDG Disparity Measured by Squared Coefficient of Variation

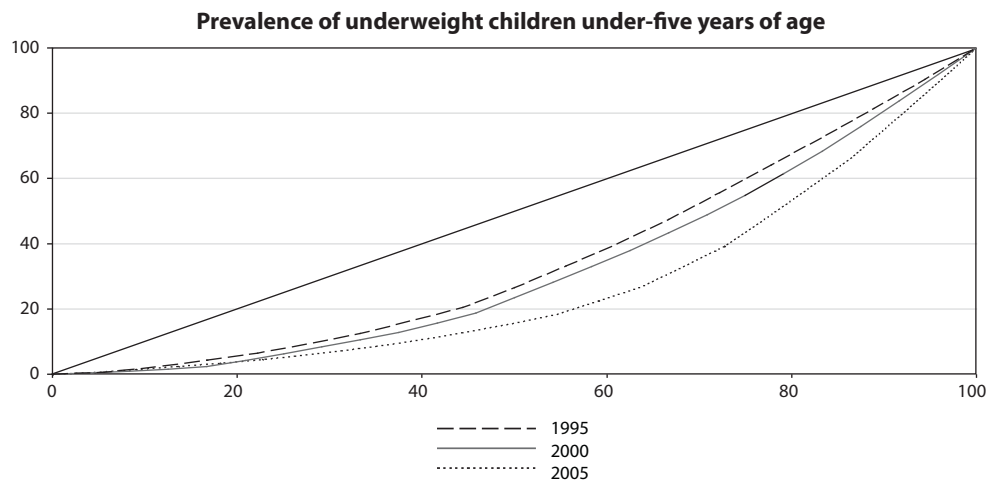
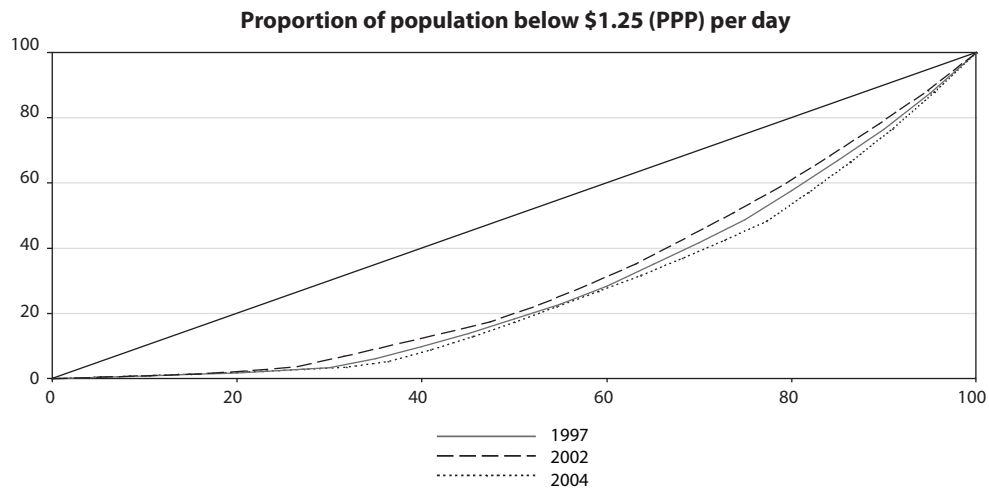
MDG Goal	Goal 1: Eradicate extreme poverty and hunger	Goal 2: Achieve universal primary education			Goal 3: Promote gender equality and empower women			Goal 4: Reduce child mortality	Goal 5: Improve maternal health				
Indicators	\$1.25 per day poverty	Underweight children	Primary enrollment	Reaching last grade	Primary completion	Gender primary	Gender secondary	Gender tertiary	Under-5 mortality	Infant mortality	Maternal mortality	Antenatal care	Skilled birth attendance
CV <sup>2</sup>	0.70	0.73	0.01	0.02	0.02	0.01	0.02	0.13	0.70	0.61	2.27	0.05	0.12
Year	2004	2005	2007	2007	2008	2008	2008	2008	2009	2008	2008	2007	2007

MDG Goal	Goal 6: Combat HIV/AIDS, malaria and other diseases												Goal 7: Ensure environmental sustainability					
Indicators	HIV prevalence	TB incidence	TB prevalence	Forest cover	CO <sup>2</sup> emissions	Protected area	Safe drinking water	Water, urban	Water, rural	Basic sanitation	Sanitation, urban	Sanitation, rural						
CV <sup>2</sup>	1.35	0.74	1.30	0.55	1.39	1.45	0.03	0.01	0.05	0.10	0.04	0.16						
Year	2007	2008	2008	2005	2007	2009	2008	2008	2008	2008	2008	2008	2008					

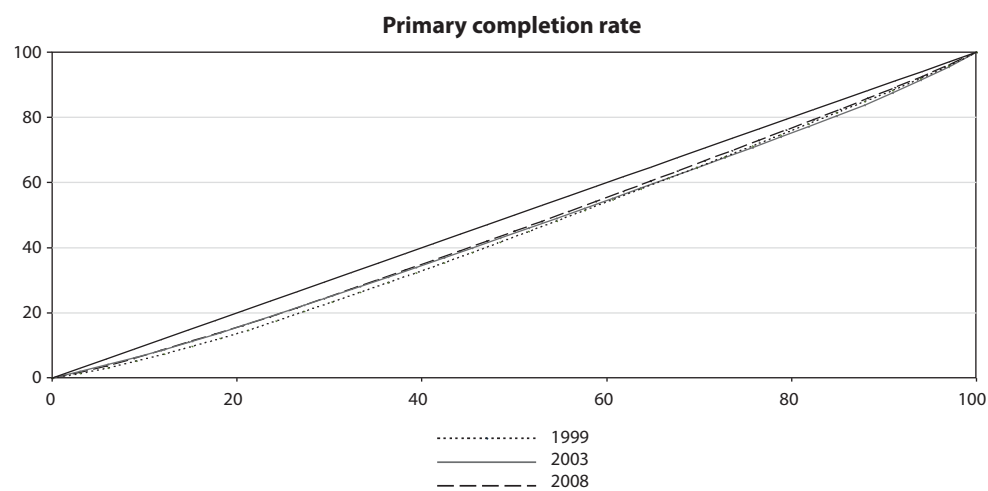
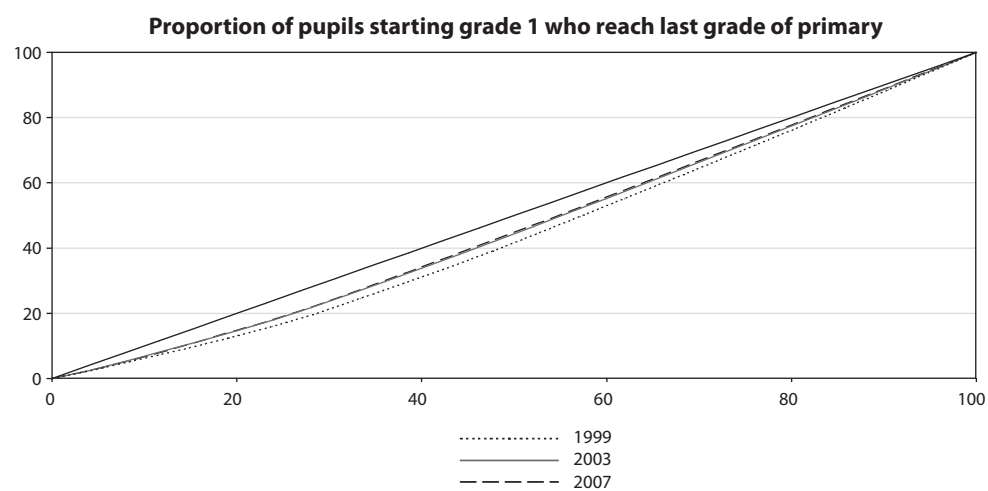
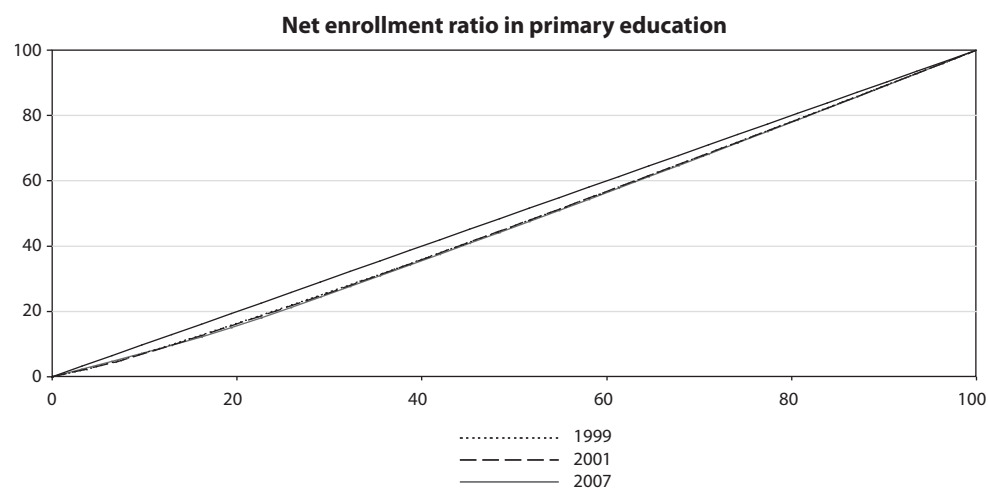
Source: Authors' calculation.

## Goal 1: Eradicate Extreme Poverty and Hunger (percent)



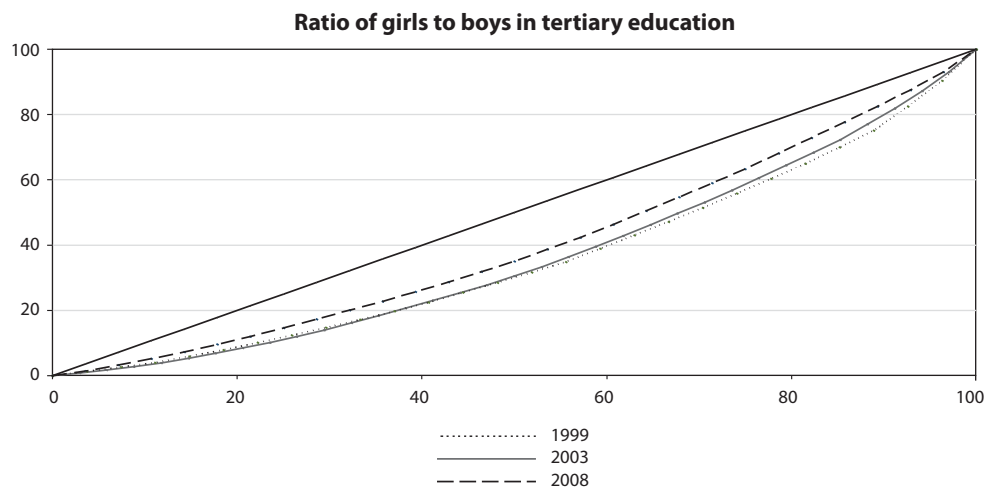
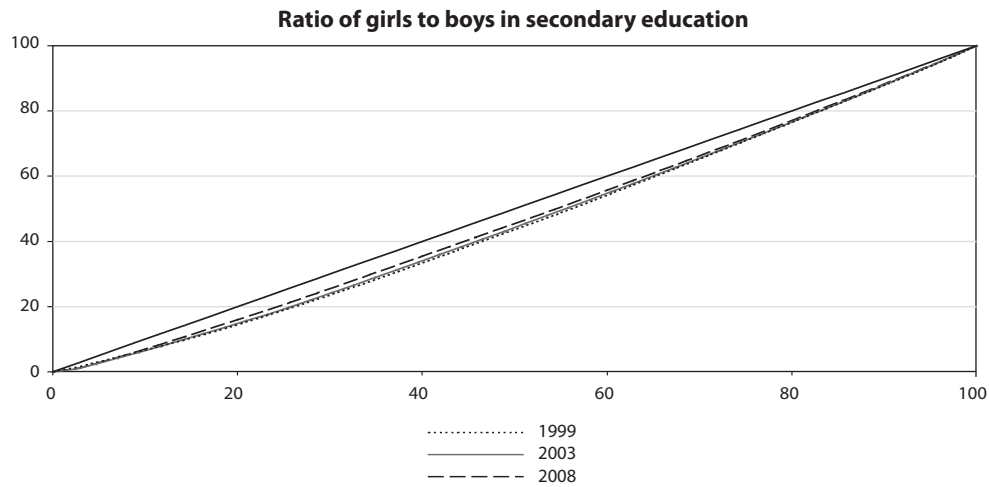
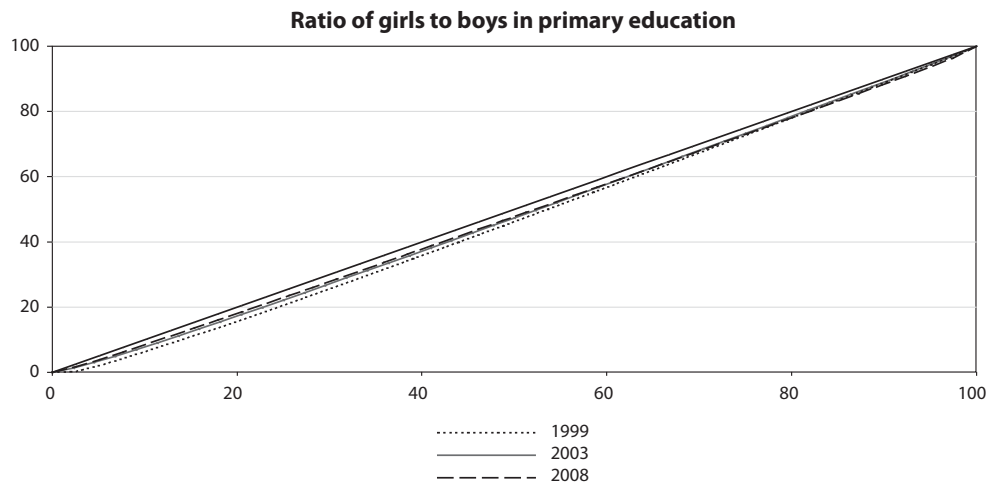
Source: Authors' compilation.

## Goal 2: Achieve Universal Primary Education (percent)



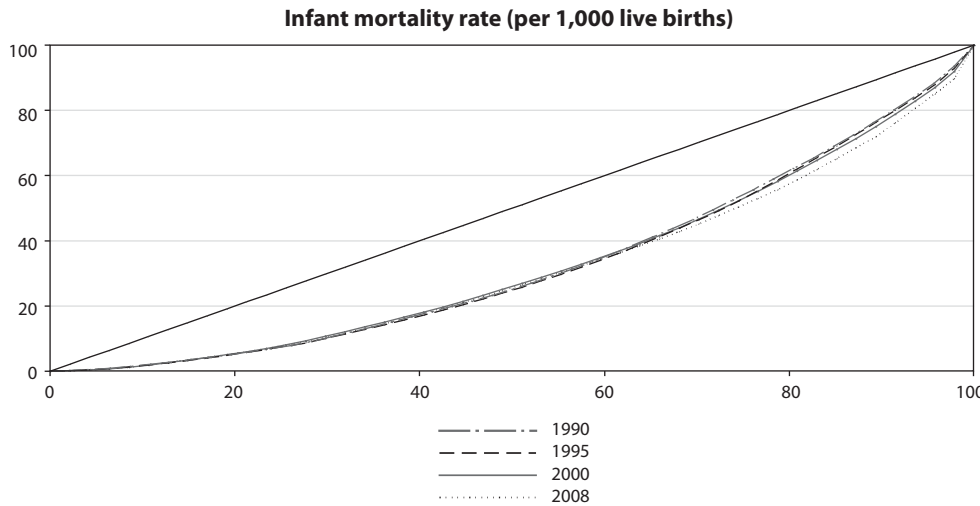
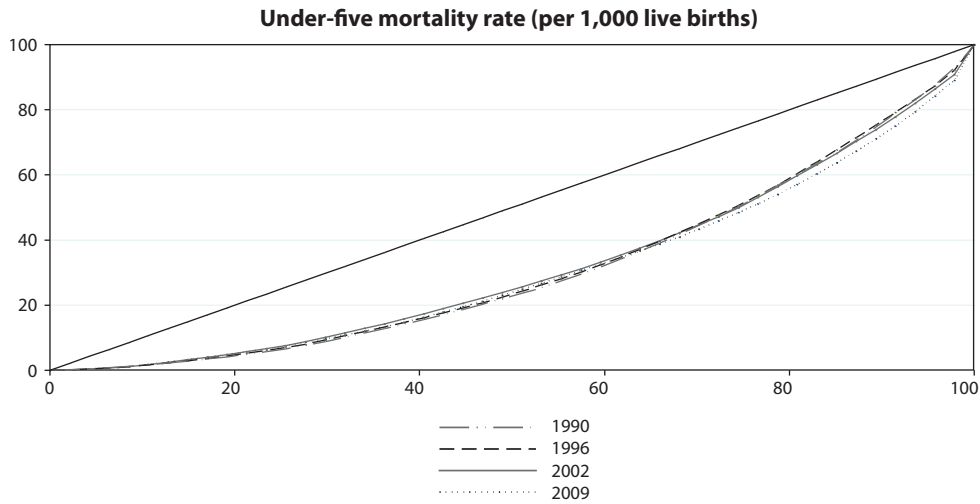
Source: Authors' compilation.

### Goal 3: Promote Gender Equality and Empower Women (percent)

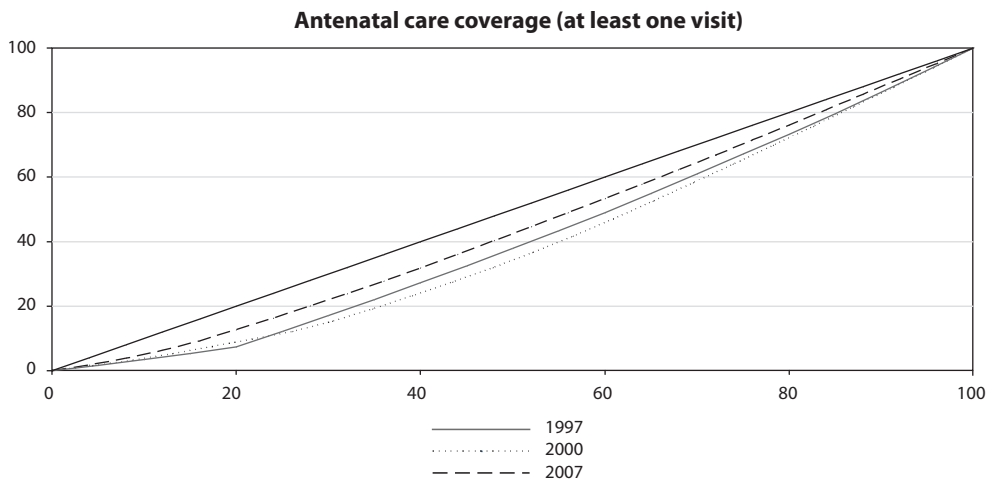
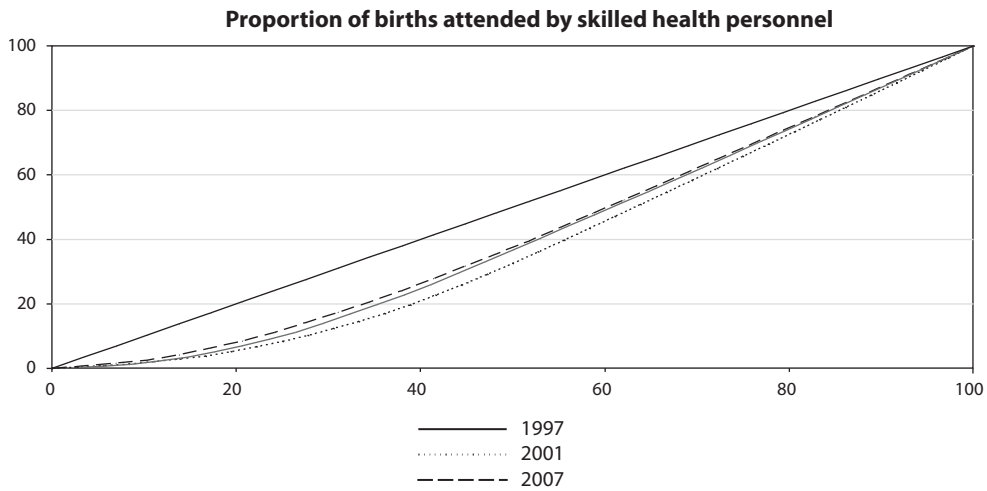
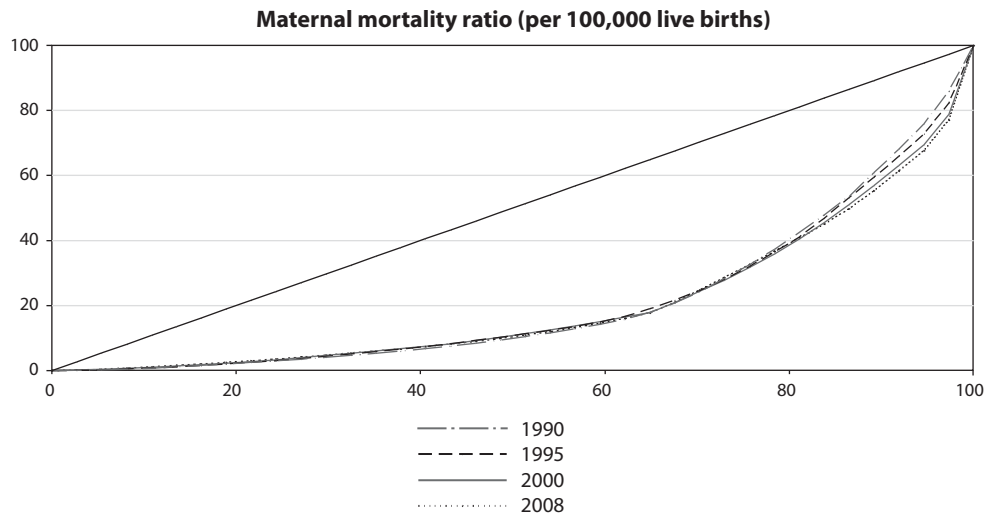


Source: Authors' compilation.

**Goal 4: Reduce Child Mortality (percent)**



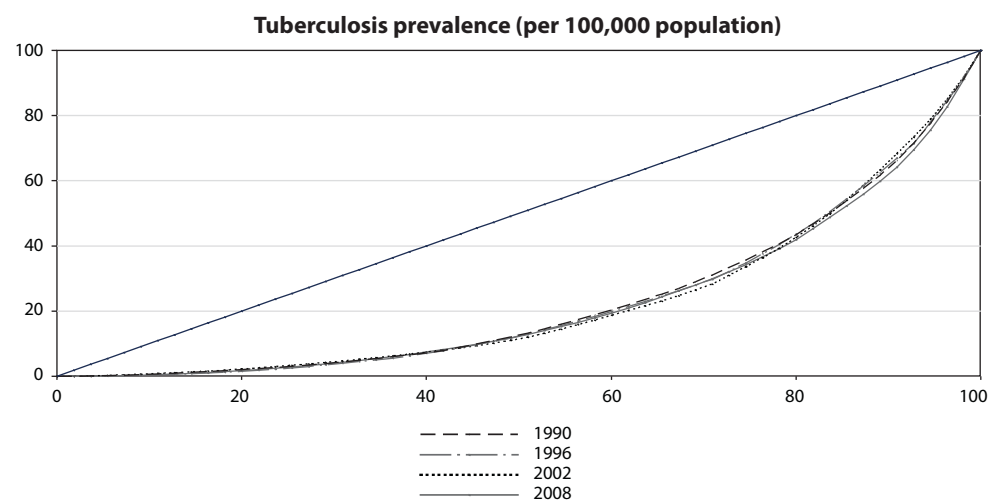
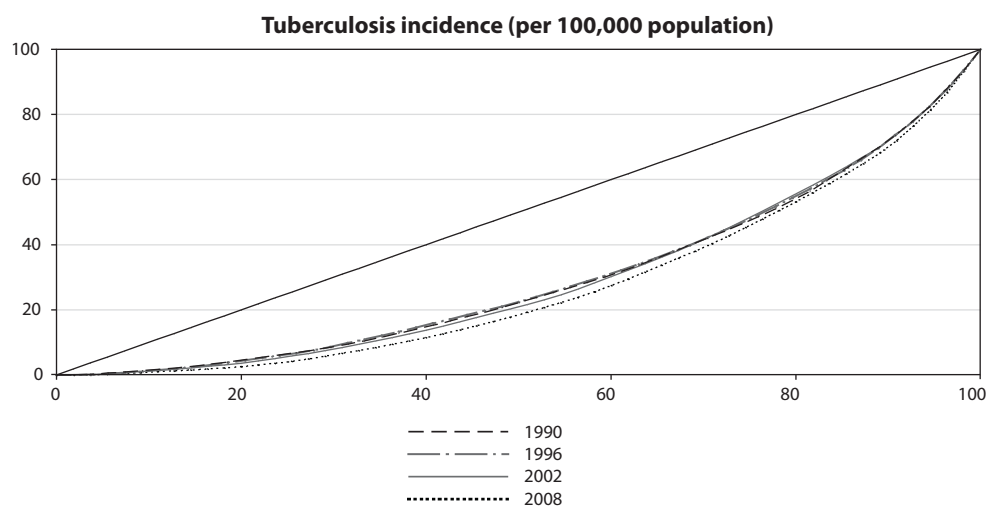
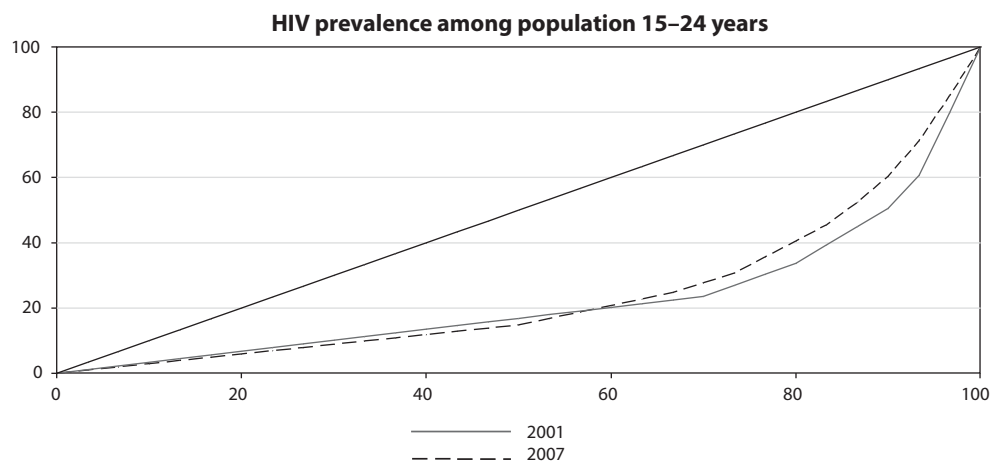
Source: Authors' compilation.

**Goal 5: Improve Maternal Health (percent)**

Source: Authors' compilation.

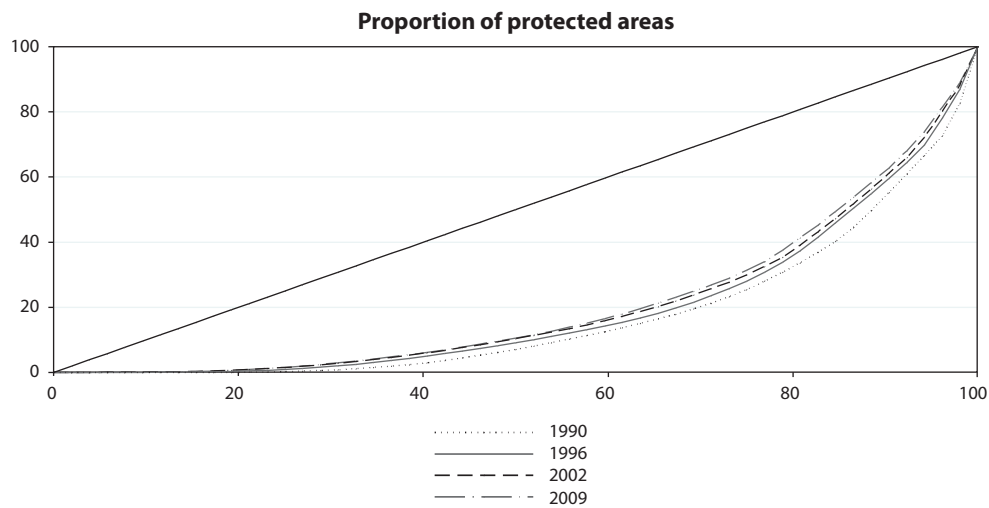
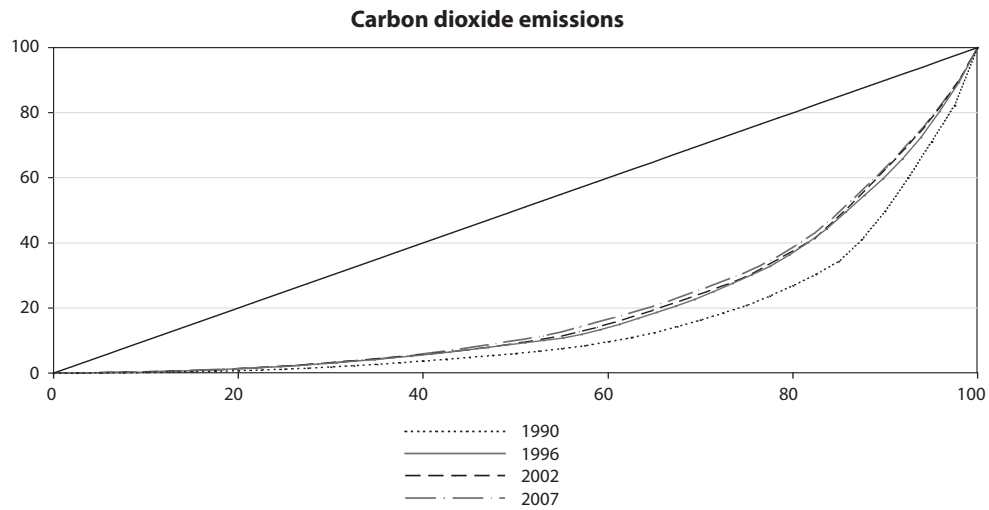
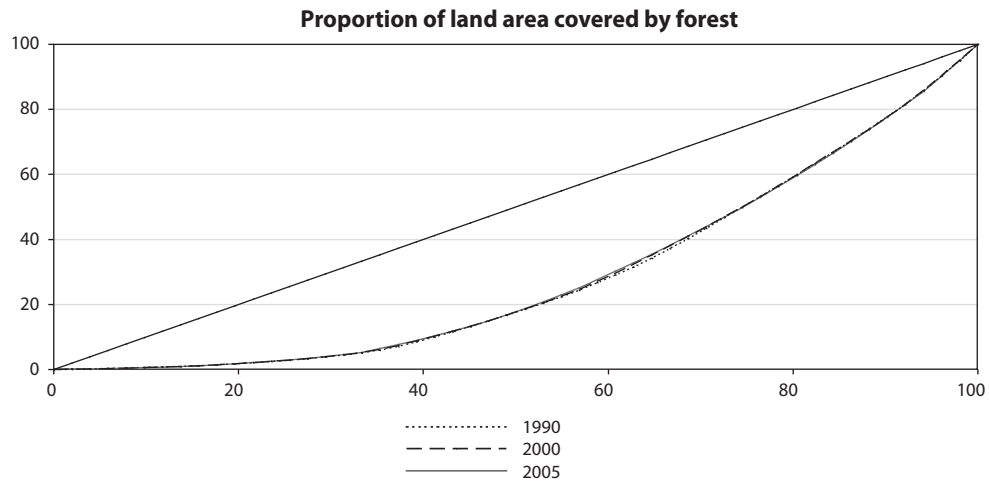


## Goal 6: Combat HIV/AIDS, Malaria and Other Diseases (percent)



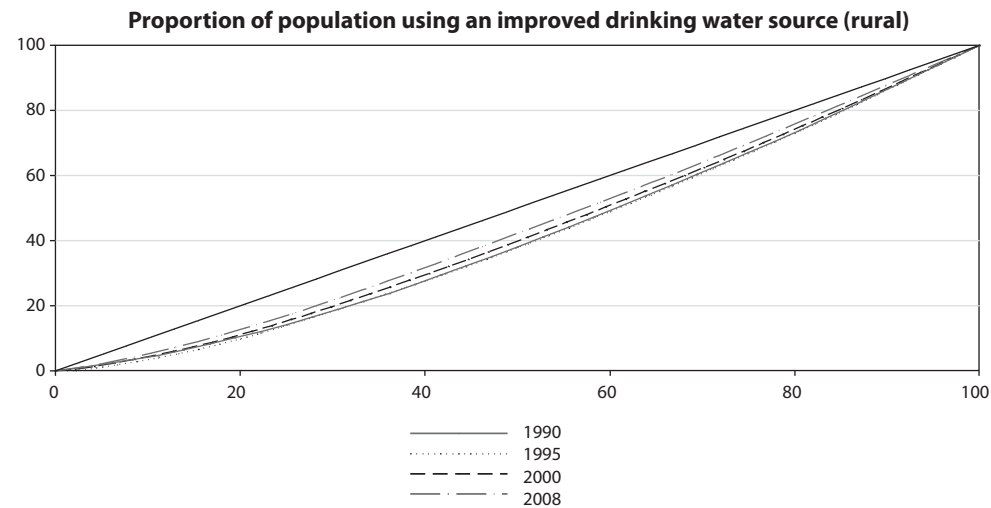
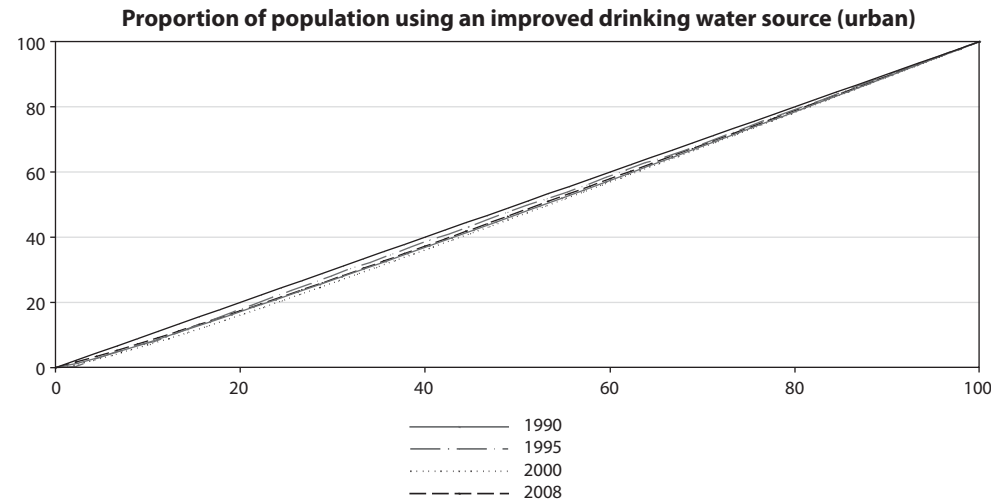
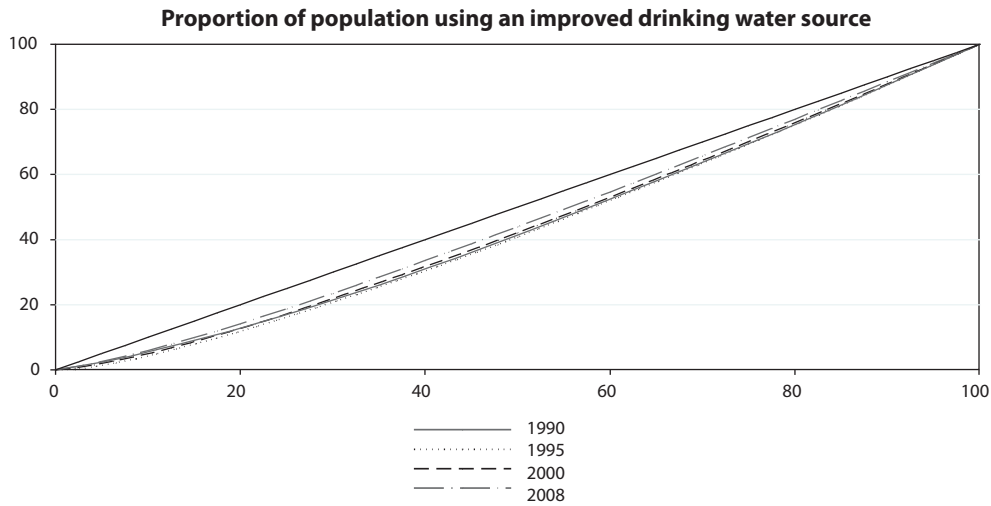
Source: Authors' compilation.

## Goal 7: Ensure Environmental Sustainability (percent)

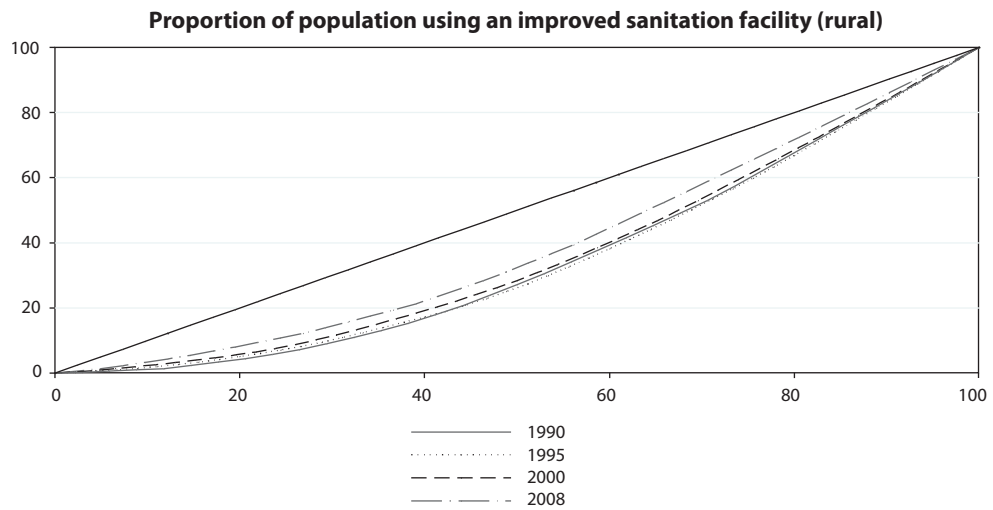
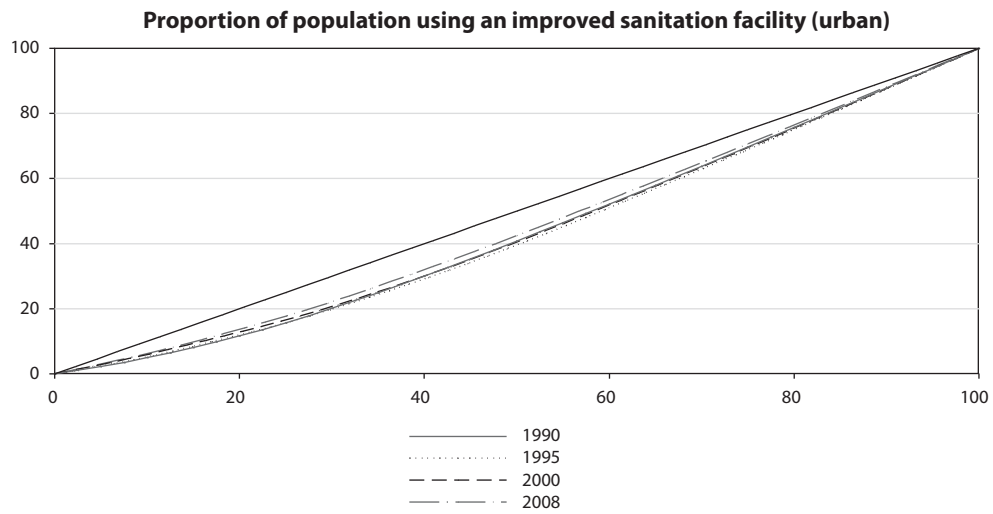
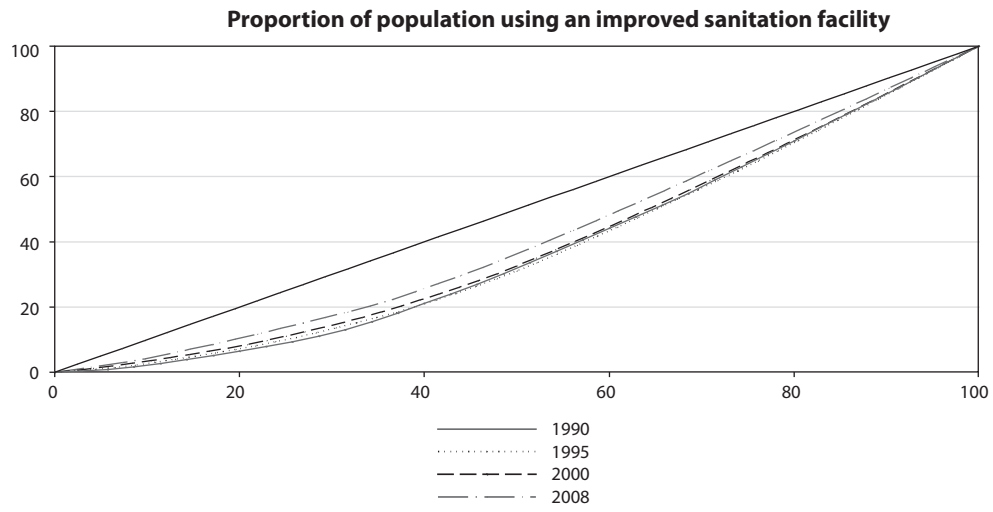


*continued.*

**Goal 7: continued.**



*continued.*

**Goal 7: continued**

Source: Authors' compilation.

On the contrary, some of the health MDGs, including maternal mortality, HIV prevalence, TB incidence, TB prevalence, and nonwater/sanitation environmental MDG indicators display very large disparities. The remaining MDG indicators have modest inequalities, including those under MDG 1 and infant and under-five mortalities. In passing, it is noted that for some individual MDGs, their Lorenz curves are close to each other, indicating little change of cross-country disparity over time. For others, visible changes can be detected. The issue of changing disparity over time will be discussed later.

While Lorenz curve is a good visual tool, it is often useful to come up with an index that summarizes the extent of disparity. The summary index makes it possible to compare disparity over time and across different MDGs. As discussed earlier in the paper, two well-known inequality measures—the Gini coefficient and the Theil index—will be used in this paper. Table 3 tabulates the estimates of the Theil index and Gini coefficient for the latest year when the relevant MDG data have good coverage of countries. The results confirm earlier findings based on Figure 1 and are consistent with measurement results using  $CV^2$ . The rank correlation coefficients between the values of  $CV^2$  and Gini index is 0.993 while that between  $CV^2$  and the Theil index is 0.975. Clearly, they are highly though not perfectly correlated.

It is known that most inequality indices are ordinal in nature and their estimates do not carry specific meanings. Further, there is no consensus in the literature on the critical level defining an unacceptable level of inequality. However, some economists take 0.4 as the critical value when discussing income inequality using the Gini index although others argue that tolerance to inequality depends on culture, tradition, and the pace of change in inequality (Wan 2006). If this practice is followed here, MDG disparities are not of serious concern except MDGs 1 and 6, maternal mortality and nonwater/sanitation environmental MDGs. Under-five and infant mortalities are on the borderline and may also deserve special attention.

Table 3: MDG Disparity Measured by the Theil Index and Gini Coefficient

MDG Goal	Goal 1: Eradicate extreme poverty and hunger	Goal 2: Achieve universal primary education	Goal 3: Promote gender equality and empower women	Goal 4: Reduce child mortality	Goal 5: Improve maternal health
Indicators	\$1.25 per day poverty	Primary enrollment	Gender primary	Under-5 mortality	Maternal mortality (=1 visit)
Indicators	Underweight children	Reaching last grade completion	Gender secondary	Infant mortality	Antenatal care
Indicators	Skilled birth attendance		Gender tertiary		
<b>Theil Index</b>	0.55	0.01	0.00	0.29	0.69
<b>Gini Coefficient</b>	0.45	0.06	0.04	0.39	0.59
<b>Year</b>	2004	2007	2008	2009	2007

MDG Goal	Goal 6: Combat HIV/AIDS, malaria and other diseases				Goal 7: Ensure environmental sustainability							
Indicators	HIV prevalence	TB incidence	TB prevalence	Forest cover	Carbon dioxide emissions	Protected area	Safe drinking water	Water, urban	Water, rural	Basic sanitation	Sanitation, urban	Sanitation, rural
Theil Index	0.47	0.39	0.63	0.50	0.78	0.89	0.02	0.00	0.03	0.06	0.02	0.10
Gini Coefficient	0.52	0.45	0.55	0.42	0.58	0.58	0.09	0.04	0.11	0.17	0.10	0.22
Year	2007	2008	2008	2005	2007	2009	2008	2008	2008	2008	2008	2008

Source: Authors' calculation.

## IV. Causes of MDG Disparities

So far attention has been focused on the overall MDG disparities for Asia as a whole and the picture is rather mixed. Some MDGs are fairly evenly distributed across countries and others are not. Having examined the level of MDG disparities, it is time to look into their causes or sources. Unless the relative importance of causal factors is known, it is difficult to design or prioritize policy options.

The conventional approach to discovering sources of disparity is to conduct inequality decompositions (see Wan 2008c). If the target variable can be expressed as a simple sum of its components (e.g., total income = wage income + investment income + transfer income), the method of Shorrocks (1982) can be applied to attribute total inequality of the target variable into contributions of the components. If the data can be split into subgroups according to a particular indicator, one can use the method of Shorrocks (1984) to estimate the contribution of the indicator to total inequality. In the context of cross-country disparity in MDGs, it is not possible to express an MDG indicator as a sum of other variables. However, countries in the Asia and Pacific region are often classified into subregions where the classifying variable is implicitly location. Countries are also often grouped into lower and higher income groups where the grouping variable is per capita income or GDP. Therefore, in this section, the roles of location and income in affecting MDG disparities will be explored.

### A. The Role of Location

Given the significant heterogeneity across subregions in Asia, one may ask which gaps are more important: the gaps across subregions or gaps among individual countries within subregions. If the former dominate, location becomes an important determinant of MDG disparity. In this case, MDG disparity is more of a regional issue and it is appropriate to target the lagging subregions. Equal improvement across countries within these subregions can help lower the overall disparity. If location is unimportant, MDG disparities are more of a subregional problem. In this case, it is important to support the lagging countries in the relevant subregion(s). Unlike in the previous case, equal improvement across countries in these subregions does not help reduce disparity at all. On the contrary, it may lead to increases in the total disparity. Clearly, under this circumstance, subregion or regionwide interventions would be ineffective. For example, if disparity in maternal mortality is found to be mainly caused by uneven development within East Asia, East Asia specific interventions can be researched, designed, and implemented accordingly. In this case, any uniform Asia-wide policy would lead to waste of resources and policy ineffectiveness, even failures.

To gauge the role of location, the estimates of Theil index reported in Table 3 can be broken into two broad components: between components, or disparities accounted for by uneven distribution across subregions; and within components, disparities accounted for by uneven distribution within subregions. The within component consists of disparities from each subregion: Central and West Asia, East Asia, the Pacific, South Asia, and Southeast Asia. The ratio of the between contribution over total disparity indicates the role of location. The decomposition results are provided in Table 4.

The last column of Table 4 shows the proportion of the between contribution in overall disparity. It is noted that there are only two values in the last column that are larger than 36%, corresponding to MDG indicators of underweight children and reaching last grade of primary school. The next largest value is 35.13 for HIV prevalence. All remaining values are smaller than 30%. Thus, location does not seem to play a major role in determining MDG disparities. In other words, MDG disparities are largely accounted for by gaps among individual countries within subregions rather than gaps across subregions. Consequently, the disparity shall be tackled by identifying lagging countries (not lagging subregions) in certain subregions.

On the other hand, all values indicating the proportion of the within contribution in the total disparity (the third last column of Table 4) exceed 56%. It is striking to see that for 20 out of the 25 MDG indicators under examination, the within component accounts for over 75% of the overall disparity. For these indicators, tackling regional disparity reduces to cutting MDG gaps within one or two key subregions. Taking maternal mortality as an example, the within component is as large as 97.13%. Literally interpreted, almost all disparities can be attributed to gaps within subregions. Further examination of the relevant decomposition results indicates that the within contribution is dominated by gaps among Central and West Asian countries and to a less extent by gaps among Southeast Asian countries. If these gaps could be eliminated, overall disparity as measured by the Theil index would drop by 0.338 and 0.181 respectively, cutting the overall disparity by 82.77%. Completely removing disparities in any context may not be possible. But narrowing down disparities among countries within one or two subregions would lower total disparity considerably and this is more feasible and cost-effective than tackling the issue as a regionwide problem.

The above findings associated with maternal mortality also apply to MDG indicators of poverty, underweight children, and HIV prevalence. For under-five mortality and infant mortality, the largest contributions come from Southeast Asia, and to a lesser extent, Central and West Asia. For disparities related to TB, protected areas, and carbon dioxide emissions, the Pacific and Central and West Asia are the largest and second largest contributors, respectively, and these two regions swap their positions as far as disparity in forest cover is concerned.



**Table 4: MDG Disparity: Decomposition of the Theil Index by Location**

	Year	Overall Disparity	Subregional Disparity					Within Contribution		Between Contribution	
			CW	EA	PAC	SA	SEA	Absolute Value	% in Overall	Absolute Value	% in Overall
Goal 1: Eradicate extreme poverty and hunger											
1	\$1.25 a day poverty	2004	0.548	0.293	0.000	0.007	0.142	0.442	80.65	0.106	19.35
2	Underweight children	2005	0.412	0.170	0.015	0.000	0.044	0.229	55.57	0.183	44.43
Goal 2: Achieve universal primary education											
3	Primary enrollment	2007	0.008	0.002	0.000	0.004	0.000	0.006	78.33	0.002	21.67
4	Reaching last grade	2007	0.013	0.000	0.000	0.001	0.002	0.004	56.59	0.006	43.41
5	Primary completion	2008	0.011	0.004	0.000	0.001	0.004	0.010	91.98	0.001	8.02
Goal 3: Promote gender equality and empower women											
6	Gender primary	2008	0.004	0.004	0.000	0.000	0.000	0.004	99.21	0.000	0.79
7	Gender secondary	2008	0.014	0.010	0.000	0.001	0.000	0.012	85.05	0.002	14.95
8	Gender tertiary	2008	0.066	0.024	0.006	0.000	0.001	0.019	76.17	0.016	23.83
Goal 4: Reduce child mortality											
9	Under-5 mortality	2009	0.286	0.075	0.019	0.035	0.027	0.103	90.49	0.027	9.51
10	Infant mortality	2008	0.263	0.065	0.023	0.036	0.014	0.108	93.04	0.018	6.96
Goal 5: Improve maternal health											
11	Maternal mortality	2008	0.692	0.338	0.051	0.044	0.058	0.181	97.13	0.020	2.87
12	Skilled birth attendance	2007	0.096	0.011	0.000	0.006	0.037	0.022	78.01	0.021	21.99
13	Antenatal care	2007	0.029	0.004	0.000	0.001	0.010	0.011	88.42	0.003	11.58
Goal 6: Combat HIV/AIDS, malaria and other diseases											
14	HIV prevalence	2007	0.472	0.119	0.000	0.048	0.048	0.091	64.87	0.166	35.13
15	TB incidence	2008	0.393	0.046	0.018	0.245	0.016	0.045	94.42	0.022	5.58
16	TB prevalence	2008	0.627	0.097	0.023	0.294	0.047	0.071	84.94	0.094	15.06
Goal 7: Ensure environmental sustainability											
17	Forest cover	2005	0.501	0.147	0.025	0.087	0.050	0.042	70.18	0.150	29.82
18	CO <sub>2</sub> emissions	2007	0.782	0.178	0.012	0.254	0.056	0.197	89.02	0.086	10.98
19	Protected area	2009	0.892	0.066	0.045	0.435	0.039	0.052	71.36	0.256	28.64
20	Safe drinking water	2008	0.019	0.005	0.001	0.008	0.000	0.005	98.32	0.000	1.68
21	Water, urban	2008	0.003	0.001	0.000	0.000	0.000	0.001	87.53	0.000	12.47
22	Water, rural	2008	0.030	0.008	0.003	0.012	0.000	0.006	97.09	0.001	2.91
23	Basic sanitation	2008	0.064	0.016	0.004	0.011	0.015	0.014	92.35	0.059	7.65
24	Sanitation urban	2008	0.021	0.003	0.002	0.006	0.005	0.002	85.96	0.003	14.04
25	Sanitation rural	2008	0.105	0.025	0.008	0.017	0.022	0.025	92.58	0.008	7.42

Source: Authors' calculation.

## **B. The Role of Income or GDP**

Conventional wisdom states that income is necessary and important for achieving social and environmental outcomes. The fact that least developed countries (LDCs) appeal for and are given aid speaks well for the role of income or GDP in social development. On the other hand, some social indicators do not necessarily improve instantaneously with income growth. Thus, it would be interesting to ask to what extent income or GDP affect MDG disparities.

One way to gather the impact of income on MDG disparities is to repeat the exercise of the preceding section by grouping countries according to GDP per capita. This can be accomplished by taking the bottom half of countries as the lower income group (LIG) and the remaining countries as the higher income group (HIG). The proportion of the between contribution in the total disparity will be used to indicate the importance of income.

Table 5 reports the decomposition results. They demonstrate the importance of income as a determinant of disparities in poverty, underweight children, maternal mortality, and to a lesser extent, in TB-related and water/sanitation-related MDG indicators. It appears that income plays a rather limited role in affecting disparities in primary enrollment, gender equality (except for secondary education), HIV prevalence, forest cover, and protected areas.

A more robust approach to quantify the role of income is to regress an MDG indicator on income or GDP per capita plus other MDG determinants, and then conduct the regression-based decomposition. This is done for the health-related MDGs below.

## **C. Accounting for Disparities in Health-Related MDGs**

In what follows, the latest technique of regression-based inequality decomposition of Wan (2004) and Wan, Lu, and Chen (2007) will be employed to explore the root causes of MDG disparities. The conventional decomposition conducted above cannot control for variables other than that for splitting data into subgroups. It is likely to yield biased results and misleading findings. A major advantage of the regression based technique is that all important variables can be considered, thus the decomposition results are less contaminated. Another advantage is that all disparities can be accounted for while this is not the case with the conventional decomposition approach.

**Table 5: MDG Disparity: Decomposition of the Theil Index by Income Group**

MDGs	Year	Overall Disparity	By Income Disparity		Within Contribution		Between Contribution	
			Low Income	Middle Income	Absolute Value	% in Overall	Absolute Value	% in Overall
Goal 1: Eradicate extreme poverty and hunger								
1	\$1.25 a day poverty	2004	0.037	0.220	0.257	42.79	0.344	57.21
2	Underweight children	2005	0.123	0.054	0.177	39.07	0.276	60.93
Goal 2: Achieve universal primary education								
3	Primary enrollment	2007	0.004	0.001	0.005	92.93	0.000	7.07
4	Reaching last grade	2007	0.009	0.000	0.009	71.08	0.004	28.92
5	Primary completion	2008	0.006	0.002	0.008	80.65	0.002	19.35
Goal 3: Promote gender equality and empower women								
6	Gender primary	2008	0.002	0.002	0.004	93.19	0.000	6.81
7	Gender secondary	2008	0.010	0.001	0.010	67.59	0.005	32.41
8	Gender tertiary	2008	0.032	0.013	0.044	91.80	0.004	8.20
Goal 4: Reduce child mortality								
9	Under-5 mortality	2009	0.074	0.134	0.208	69.50	0.091	30.50
10	Infant mortality	2008	0.077	0.117	0.194	71.63	0.077	28.37
Goal 5: Improve maternal health								
11	Maternal mortality	2008	0.256	0.120	0.375	50.55	0.367	49.45
12	Skilled birth attendance	2007	0.088	0.003	0.091	80.41	0.022	19.59
13	Antenatal care	2007	0.026	0.001	0.027	81.10	0.006	18.90
Goal 6: Combat HIV/AIDS, malaria and other diseases								
14	HIV prevalence	2007	0.228	0.263	0.491	99.88	0.001	0.12
15	TB incidence	2008	0.094	0.102	0.196	65.45	0.103	34.55
16	TB prevalence	2008	0.157	0.119	0.276	56.18	0.216	43.82
Goal 7: Ensure environmental sustainability								
17	Forest cover	2005	0.259	0.258	0.517	97.83	0.011	2.17
18	CO <sub>2</sub> emissions	2007	0.294	0.176	0.471	56.25	0.366	43.75
19	Protected area	2009	0.412	0.275	0.687	97.79	0.016	2.21
20	Safe drinking water	2008	0.014	0.001	0.015	69.54	0.006	30.46
21	Water, urban	2008	0.002	0.000	0.002	71.46	0.001	28.54
22	Water, rural	2008	0.023	0.002	0.025	71.71	0.010	28.29
23	Basic sanitation	2008	0.038	0.012	0.049	69.45	0.022	30.55
24	Sanitation urban	2008	0.011	0.004	0.015	69.99	0.006	30.01
25	Sanitation rural	2008	0.059	0.018	0.077	67.13	0.038	32.87

Source: Authors' calculation.

We will focus on four health-related MDGs only: maternal mortality, under-five mortality, infant mortality, and underweight children. This is because these four indicators have large disparities and are attracting considerable attention by the development community and policy makers worldwide (see earlier discussions). Also, it is partly due to shortage of data on explanatory variables for other MDGs for modeling purposes.

Generally speaking, the first step is to establish a relationship between an MDG indicator and its determinants, denoted by  $X_s$ :

$$\text{MDG} = f(X_s) \quad (1)$$

where  $f$  denotes a functional form that can be linear or nonlinear. The  $X_s$  can enter the function as individual variables or interactive variables. The second step is to apply the regression-based inequality decomposition technique of Wan (2004) by taking inequality on both sides of the above model:

$$\text{Ine}(\text{MDG}) = \text{Ine} [f(X_s)] \quad (2)$$

where  $\text{Ine}$  denotes computation of an inequality measure such as Gini or Theil index. Relying on the Shapley procedure based on cooperate game theory (Shorrocks 1999), it is possible to break down the total inequality  $\text{Ine} [f(X_s)]$  into components attributable to individual  $X_s$ . Thus, we have:

$$\text{Ine}(\text{MDG}) = \sum \text{Contributions of } X_s \text{ to total inequality} \quad (3)$$

Dividing both sides of the above equation by  $\text{Ine}(\text{MDG})$  produces relative contributions of relevant variables to the overall disparities, including the residual term and those variables that are not subject to policy interventions such as country location.

Table 6 lists the dependent and independent variables and their definitions, including unit of measurement. Again, due to data shortage some of the potentially important variables cannot be included and some of the variables probably could have been measured better. For example, the rate of primary enrollment is included to indicate human capital due to absence of frequent information on years of schooling, which is a better indicator of education level. Nevertheless, as shown in Table 7, the empirical models are of reasonable quality. In particular, the squared correlation coefficients  $r^2$  between the observed and predicted values of dependent variables are all larger than 0.80, indicating high goodness of fit. Further, all parameters except two in the last column of Table 7 are statistically significant at the 5% level of significance.

**Table 6: Variables Used in the Regression Models**

Variable	Notation	Definition
Underweight children	$Y_{\text{underweight}}$	Percentage of children under five years old whose weight for age is less than minus two standard deviations from the median for the international reference population ages 0–59 months.
Under-5 mortality	$Y_{\text{u5\_mort}}$	Probability (expressed as rate per 1,000 live births) of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates.
Infant mortality	$Y_{\text{inf\_mort}}$	Number of infants dying before reaching the age of one year per 1,000 live births in a given year.
Maternal mortality	$Y_{\text{mat\_mort}}$	Number of women who die from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 live births.
GDP per capita, PPP	$X_{\text{gdppc}}$	PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. Data are in constant 2005 international dollars.
Urban population	$X_{\text{urb\_pop}}$	Urban population (as % of total) refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects.
Primary enrollment	$X_{\text{prim\_enrol}}$	Ratio of the number of children of official school age (as defined by the national education system) who are enrolled in primary school to the total population of children of official school age.
Health expenditure, private	$X_{\text{h\_expprv}}$	Private health expenditure (as % of GDP) includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations.
Health expenditure, public	$X_{\text{h\_exppub}}$	Public health expenditure (as % of GDP) consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.
Immunization, DPT	$X_{\text{immu\_dpt}}$	Percentage of children ages 12–23 months who received vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized against diphtheria, pertussis (or whooping cough), and tetanus (DPT) after receiving three doses of vaccine.
Skilled birth attendance	$X_{\text{skilled\_bir}}$	Percentage of deliveries attended by personnel trained to give the necessary supervision, care, and advice to women during pregnancy, labor, and the post-partum period; to conduct deliveries on their own; and to care for newborns.
Basic sanitation	$X_{\text{sani}}$	Percentage of the population with access to facilities that hygienically separate human excreta from human, animal, and insect contact.
Safe water	$X_{\text{water}}$	Percentage of the population who use any of the following types of water supply for drinking: piped water, public tap, borehole or pump, protected well, protected spring, or rainwater.
Dummy for East Asia	$X_{\text{regEA}}$	
Dummy for Pacific	$X_{\text{regPAC}}$	
Dummy for South Asia	$X_{\text{regSA}}$	
Dummy for Southeast Asia	$X_{\text{regSEA}}$	
Year	$X_{\text{year}}$	

Source: Authors' compilation.

**Table 7. Modeling MDGs by Box-Cox Regression**

Independent Variables	Dependent Variables							
	ln (Y <sub>underweight</sub> )		ln (Y <sub>u5_mort</sub> )		ln (Y <sub>inf_mort</sub> )		ln (Y <sub>mat_mort</sub> )	
ln (X <sub>gdp</sub> )	-0.205	(0.000)	-0.521	(0.000)	-0.463	(0.000)	-0.216	(0.000)
X <sub>urb_pop</sub> **	-0.006	(0.014)	5.982	(0.002)	494.834	(0.000)	-0.002	(0.348)
X <sub>prim_enrol</sub> ***	0.010	(0.001)			-0.006	(0.000)	-0.001	(0.044)
X <sub>h_expprv</sub>	-0.060	(0.004)	-0.067	(0.000)	-0.055	(0.000)	-0.059	(0.000)
X <sub>h_exppub</sub> *	0.002	(0.001)	0.291	(0.054)	0.081	(0.017)	0.028	(0.005)
X <sub>immu_dpt</sub>			-0.005	(0.021)	-0.006	(0.000)		
X <sub>skilled_bir</sub>							-0.017	(0.000)
X <sub>sani</sub>	-0.011	(0.000)	-0.011	(0.000)	-0.009	(0.000)	-0.013	(0.000)
X <sub>regEA</sub>	-0.225	(0.029)	-0.875	(0.000)	-0.742	(0.000)	-0.287	(0.000)
X <sub>regPAC</sub>	0.428	(0.018)	-0.793	(0.000)	-0.609	(0.000)	-0.696	(0.000)
X <sub>regSA</sub>	1.135	(0.000)	-0.182	(0.002)	-0.206	(0.001)	0.086	(0.330)
X <sub>regSEA</sub>	0.958	(0.000)	-0.543	(0.000)	-0.647	(0.000)	0.199	(0.003)
X <sub>year</sub>	-0.035	(0.000)	-0.023	(0.000)	-0.011	(0.001)	-0.010	(0.024)
r <sup>2</sup>	0.880		0.809		0.826		0.910	

\* with Box-Cox transformation.

\*\* with Box-Cox transformation except for Y<sub>underweight</sub> and Y<sub>mat\_mort</sub>.

\*\*\* with Box-Cox transformation for Y<sub>mat\_mort</sub> only.

Source: Authors' calculation.

Majority of parameter estimates are of signs as expected. It is noted that the variable of public health expenditure entered the models after Box-Cox transformation to allow nonlinearity. Thus, its coefficient estimates may turn out to be positive. This is acceptable as long as the transformation parameter is negative as is the case with under-five mortality and infant mortality. It is interesting to observe that the time trend variable is negatively correlated with all the four MDGs, indicating improvement in these MDGs over time as driven by factors other than those included in the model. These may include variables such as technology advances, policy improvement in governance and general policy environment, and so on.

It is not surprising that different MDGs are determined by different sets of factors, and the same factor can exert different impacts, depending on the MDG indicator. For example, GDP per capita is highly significant in all the equations but its impacts on infant and under-five mortalities are larger than on maternal mortality and underweight children. However, every one unit improvement in sanitation exerts similar impacts on all the MDG health indicators of Table 7. Also, private health expenditure seems to be more effective than public health expenditure in promoting MDGs, and its impacts are larger on underweight children and under-five mortality than on other health MDGs. All these findings can help policy makers in prioritizing sector and thematic interventions.

As mentioned earlier, maternal mortality deserves special attention due to its large disparity. The relevant estimation results indicate that for every percentage increase in per capita GDP, mortality rate is expected to decline by 0.22%. For every percentage improvement in skilled birth attendance, mortality would reduce by 0.02%. As expected,

urbanization, private health expenditure, and human capital development as represented by primary enrollment ratio all help to lower maternal mortality. Overall, the squared correlation coefficient between the predicted and actual values of the dependent variable is as large as 0.91. Other models listed in Table 7 can be interpreted in a similar way.

It is important to point out that the regression models of Table 7 can only provide information and insights about the levels of MDGs, not disparities of MDGs, which is the theme of this paper. To gain insights into the contributors of MDG disparities, the regression-based decomposition technique can be applied to the estimated models. Before proceeding any further, several points are worth mentioning. First, the dummy variables in the models capture location effects. It is thus appropriate to combine them into one variable to be named “Location”. Second, the time trend variable can be removed from the models before decomposition is undertaken. This is because all the four MDG variables are expressed in logarithm terms in the models, and when solving a model for the original MDG values, the term associated with the time trend variable becomes a multiplicative constant for any particular year. As disparities are studied on an individual year basis, removing this multiplicative constant does not change inequality measurement or decomposition as long as relative inequality measures such as the Theil index and Gini coefficient are used. The same can be said about the constant term in the models. Finally, the residual term is treated as a separate variable, capturing effects of factors not present in the relevant model.

Table 8 reports the decomposition results for two separate years. It provides percentage contributions of the various factors in constituting the relevant MDG disparity. A few interesting findings can be extracted. First, the residual contribution varies from almost nil to 35% (for under-five mortality in 2009). In other words, factors included in the model can account for at least 65% of total disparities. Second, location contributes over 40% to total disparity in underweight children. But its contribution is negligible in terms of disparity in maternal mortality. There seems a declining importance of location, evidenced by reductions in its contributions from the early year to the later year, for all the four MDG indicators.

**Table 8a: Sources of Disparities in Underweight Children**

Independent Variables	1999				2006			
	Gini	Gini %	GE a=0.0	GE %	Gini	Gini %	GE a=0.0	GE %
X <sub>urb_pop</sub>	0.04	9.96	0.04	10.92	0.04	10.33	0.04	8.25
ln (X <sub>gdp</sub> )	0.05	12.06	0.04	11.16	0.04	11.24	0.07	14.17
X <sub>h_expprv</sub>	0.01	2.21	0.00	1.17	0.01	3.12	0.00	-1.03
X <sub>h_exppub</sub>	0.01	1.46	0.00	0.98	0.00	0.94	0.10	20.25
X <sub>prim_enrol</sub>	0.00	0.22	-0.01	-3.46	0.00	0.11	-0.03	-5.74
X <sub>sani</sub>	0.11	26.61	0.09	25.53	0.10	28.65	0.11	23.46
Location	0.19	47.46	0.19	53.72	0.16	45.62	0.19	40.62
Residual	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.02
Total	0.40	100.00	0.35	100.00	0.35	100.00	0.48	100.00

**Table 8b: Sources of Disparities in Under-five Mortality**

Independent Variables	1995				2009			
	Gini	Gini %	GE a=0.0	GE %	Gini	Gini %	GE a=0.0	GE %
X <sub>urb_pop</sub>	-0.004	-1.4	-0.019	-10.2	0.003	1.1	-0.008	-4.8
ln (X <sub>gdp</sub> )	0.092	30.0	0.076	41.0	0.091	30.1	0.061	38.5
X <sub>h_expprv</sub>	0.001	0.3	-0.006	-3.2	0.002	0.6	-0.005	-3.4
X <sub>h_exppub</sub>	0.008	2.8	0.000	0.1	-0.001	-0.4	-0.007	-4.3
X <sub>sani</sub>	0.077	25.3	0.055	29.7	0.076	25.2	0.049	31.0
X <sub>immu_dpt</sub>	0.020	6.5	0.015	7.9	0.011	3.6	0.006	3.8
Location	0.057	18.5	0.036	19.3	0.034	11.3	0.007	4.3
Residual	0.055	18.0	0.029	15.5	0.086	28.5	0.056	35.0
Total	0.305	100.0	0.185	100.0	0.303	100.0	0.159	100.0

**Table 8c: Sources of Disparities in Infant Mortality**

Independent Variables	1995				2009			
	Gini	Gini %	GE a=0.0	GE %	Gini	Gini %	GE a=0.0	GE %
X <sub>urb_pop</sub>	-0.016	-5.8	-0.027	-17.8	0.007	2.4	-0.002	-1.8
ln (X <sub>gdp</sub> )	0.083	30.0	0.063	41.3	0.091	33.0	0.054	39.7
X <sub>h_expprv</sub>	-0.001	-0.4	-0.006	-3.7	0.001	0.3	-0.004	-3.0
X <sub>h_exppub</sub>	0.006	2.3	0.002	1.4	0.000	-0.2	-0.001	-0.6
X <sub>prim_enrol</sub>	0.017	6.3	0.009	5.9	0.009	3.4	0.005	3.8
X <sub>immu_dpt</sub>	0.023	8.4	0.015	9.6	0.014	5.0	0.007	5.2
X <sub>sani</sub>	0.062	22.5	0.039	25.6	0.065	23.7	0.037	27.5
Location	0.051	18.4	0.030	19.4	0.027	9.8	0.004	2.7
Residual	0.051	18.5	0.028	18.4	0.062	22.6	0.036	26.4
Total	0.276	100.0	0.153	100.0	0.276	100.0	0.136	100.0

**Table 8d: Sources of Disparities in Maternal Mortality**

Independent Variables	1995				2009			
	Gini	Gini %	GE a=0.0	GE %	Gini	Gini %	GE a=0.0	GE %
X <sub>urb_pop</sub>	0.012	2.2	0.015	2.4	0.009	1.8	0.010	1.9
ln (X <sub>gdp</sub> )	0.047	8.5	0.056	9.4	0.058	11.0	0.064	12.4
X <sub>h_expprv</sub>	0.005	0.8	-0.003	-0.6	0.005	0.9	-0.003	-0.7
X <sub>h_exppub</sub>	0.000	0.0	-0.005	-0.9	0.007	1.3	0.001	0.3
X <sub>prim_enrol</sub>	0.019	3.4	0.021	3.5	0.010	1.8	0.010	1.9
X <sub>skilled_bir</sub>	0.240	43.8	0.286	47.7	0.223	42.4	0.241	46.6
X <sub>sani</sub>	0.127	23.1	0.155	25.9	0.099	18.9	0.107	20.7
Location	0.038	7.0	0.043	7.1	0.013	2.5	-0.006	-1.2
Residual	0.061	11.1	0.033	5.5	0.102	19.3	0.093	18.1
Total	0.548	100.0	0.599	100.0	0.526	100.0	0.517	100.0

Source: Authors' calculation.



Third, the contribution of income as represented by per capita GDP is small as far as infant mortality disparity is concerned, but is large with respect to under-five mortality, and moderate for the other two MDGs. Finally, one may ask what the most important factors are in constituting MDG gaps across countries. The answer of course differs with the MDG indicators. For underweight children, location is most important, followed by sanitation then GDP. For under-five mortality, GDP is most important, closely followed by sanitation and location. The same can be said for infant mortality. The case of maternal mortality is a little different. Skilled birth attendance accounts for over 40% of total disparity, sanitation around 20%, GDP around 10%.

## V. Convergence or Divergence?

So far, MDG disparities are largely discussed from a static perspective. It is natural to move into a dynamic perspective. One way of doing so is to assess whether MDGs are converging or diverging. If the answer is divergence, urgent actions are needed to reverse the trend by combating the disparities. Even if convergence is found, it is useful to gather information on the speed of convergence. A more homogeneous Asia and Pacific region means better harmony, improved prospect of integration, and shared prosperity.














The literature of convergence is typically on growth but can be applied to MDGs. In fact, for those MDG indicators expressed in ratios and percentages, convergence is almost inevitable in the very long run. Broadly speaking, two types of convergence can be examined: conditional and unconditional. The former requires modeling of MDGs with other key determinants included while the latter simply uses initial values of the dependent variable as the explanatory variable in a simple regression. In both cases, panel data modeling with sufficient time-series length is needed (Wan 2005). This is not possible in this paper due to shortage of data.

A simple alternative is to compare MDG Lorenz curves for different years. When the Lorenz curves do not intersect, it is easy to draw conclusions. Otherwise, the concept of stochastic dominance must be introduced to aid such comparisons (Anderson, Findlay, and Wan 1990). A quick look at Figure 2 reveals that many Lorenz curves intersect. In particular, for primary enrollment, TB prevalence, forest cover, and under-five mortality, their Lorenz curves are so close to each other that it becomes difficult to distinguish them. Nevertheless, the remaining 22 plots of Lorenz curves can be classified into three groups. The first group shows convergence, which includes primary completion, reaching last grade, MDG 3, HIV prevalence, and nonwater/sanitation MDG 7. The second group shows divergence, encompassing underweight children, infant mortality, maternal mortality, TB incidence, and rural water. The remaining MDGs demonstrate an inverted U pattern except poverty, which exhibits a U pattern.

If the year 2002 is discarded, MDG disparities rose over time for both the poverty and hunger indicators of MDG 1. This finding is important because Asia has been hailed as a success story for poverty reduction but our finding indicates that this comes with a widening disparity. Turning to MDGs 2–4, the Lorenz curves are all close to each other, indicating little or very small changes in disparity over time although gender equity in tertiary institutions seems to have improved even as divergence emerged in the top segments of the MDG 4 distributions. The same divergence can be detected for maternal mortality, while convergence is visible in skilled birth attendance and antenatal care. No clear trend can be detected for the three indicators under MDG 6 except that a slight divergence is noticeable in TB incidence. Regarding MDG 7, carbon dioxide emission displays convergence and other indicators are associated with small, perhaps insignificant, changes in disparity over time.

Salas (2002) proposes to link inequality decomposition to the recent literature on convergence. In particular, examining the time trend of the between component may offer a better method of studying convergence than the conventional Beta or sigma convergence techniques. Following Salas, estimates of the cross-country inequality as measured by Gini coefficient and Theil index are provided in Table 9, with the last column indicating changing trend over time. What can be discerned from Table 9 broadly confirm earlier findings when Lorenz curves were examined.

**Table 9: Changes in MDG Disparities over Time**

	Indicator	Year	Gini Coefficient	Theil Index	Trend
Goal 1: Eradicate extreme poverty and hunger					
1	\$1.25 per day poverty	1997	0.426	0.507	
		2002	0.388	0.415	
		2004	0.452	0.548	
2	Underweight children	1995	0.296	0.210	
		2000	0.348	0.296	
		2005	0.454	0.412	
Goal 2: Achieve universal primary education					
3	Primary enrollment	1999	0.055	0.007	
		2001	0.056	0.008	
		2007	0.060	0.008	
4	Reaching last grade	1999	0.111	0.025	
		2003	0.079	0.014	
		2007	0.074	0.013	
5	Primary completion	1999	0.099	0.022	
		2003	0.087	0.014	
		2008	0.074	0.011	
Goal 3: Promote gender equality and empower women					
6	Gender primary	1999	0.061	0.042	
		2003	0.041	0.005	
		2008	0.037	0.004	
7	Gender secondary	1999	0.090	0.016	
		2003	0.085	0.018	
		2008	0.068	0.014	
8	Gender tertiary	1999	0.282	0.131	
		2003	0.270	0.127	
		2008	0.199	0.066	
Goal 4: Reduce child mortality					
9	Under-5 mortality	1990	0.378	0.282	
		1996	0.371	0.277	
		2002	0.367	0.267	
		2009	0.387	0.286	
10	Infant mortality	1990	0.343	0.234	
		1995	0.351	0.247	
		2000	0.347	0.244	
		2008	0.365	0.263	
Goal 5: Improve maternal health					
11	Maternal mortality	1990	0.579	0.726	
		1995	0.581	0.702	
		2000	0.590	0.687	
		2008	0.593	0.692	
12	Skilled birth attendance	1997	0.190	0.145	
		2001	0.229	0.168	
		2007	0.172	0.096	
13	Antenatal care (= 1 visit)	1997	0.175	0.089	
		2000	0.203	0.087	
		2007	0.109	0.029	

*continued.*

**Table 9: continued**

	Indicator	Year	Gini Coefficient	Theil Index	Trend
Goal 6: Combat HIV/AIDS, malaria and other diseases					
14	HIV prevalence	2001	0.549	0.553	↘
		2007	0.518	0.472	
15	TB incidence	1990	0.405	0.260	↗
		1996	0.402	0.276	
		2002	0.412	0.362	
		2008	0.447	0.393	
16	TB prevalence	1990	0.538	0.658	↗
		1996	0.544	0.725	
		2002	0.546	0.658	
		2008	0.552	0.627	
Goal 7: Ensure environmental sustainability					
17	Forest cover	1990	0.424	0.506	↘
		2000	0.421	0.502	
		2005	0.420	0.501	
18	Carbon dioxide emissions	1990	0.683	1.152	↘
		1996	0.601	0.837	
		2002	0.591	0.815	
		2007	0.579	0.782	
19	Protected area	1990	0.656	0.497	?* ↘
		1996	0.617	0.754	
		2002	0.594	0.906	
		2009	0.581	0.892	
20	Safe drinking water	1990	0.119	0.029	↻
		1995	0.130	0.076	
		2000	0.112	0.034	
		2008	0.087	0.019	
21	Water, urban	1990	0.043	0.006	↻
		1995	0.060	0.030	
		2000	0.054	0.011	
		2008	0.036	0.003	
22	Water, rural	1990	0.164	0.056	↻
		1995	0.171	0.120	
		2000	0.144	0.050	
		2008	0.113	0.030	
23	Basic sanitation	1990	0.240	0.155	↘
		1995	0.241	0.132	
		2000	0.222	0.104	
		2008	0.175	0.064	
24	Sanitation urban	1990	0.127	0.037	↻
		1995	0.137	0.038	
		2000	0.124	0.029	
		2008	0.101	0.021	
25	Sanitation rural	1990	0.299	0.253	↘
		1995	0.302	0.214	
		2000	0.280	0.173	
		2008	0.221	0.105	

Note: The trend provided by the Gini differs from that by the Theil index.

Source: Authors' calculation.

## VI. Summary and Policy Implications

Relying on formal and informal tools, this paper represents an early attempt to study cross-country disparities in 25 MDGs, with a special emphasis on health-related MDGs. Analytical results are robust to different research techniques and provide useful information for those who are concerned about MDG disparities across countries. As argued in the introduction of this paper, such disparities are associated with some of the most serious socioeconomic issues facing the Asia and Pacific region today.

The paper began with identifying the “symptom” of the research problem by measuring the extent of between-country MDG disparities. This led to “diagnosis”—examining the causes or contributors of these disparities. Now it is appropriate to provide “prescriptions” by highlighting major policy implications derivable from research findings.

First, maternal mortality, infant mortality, under-five mortality, underweight children, and poverty are associated with quite large disparities, so are MDG 6 and nonwater/sanitation MDG 7. Given the potential consequences of large MDG disparities, this finding can be used to raise or enhance awareness of the MDG disparity challenge to national, regional, and international institutions. Second, all the health-related MDGs just mentioned show signs of divergence though this is not the case for MDG 7. This result is valuable. At the minimum, it offers a warning sign to policy makers and appeals for urgent actions to address health-related MDG disparities. Third, a large and significant portion of disparities in most of the health-related MDGs is attributable to sanitation, which, interestingly, has small disparities itself. Therefore, priorities should be given to sanitation improvement in development programs and projects. Bridging sanitation gaps across countries are within reach and can help narrow down health-related MDG disparities by more than 40%. Fourth, leaving location aside, which is not easily amendable to policy interventions, GDP per capita as a proxy of income is the most or second most important force driving disparities in underweight children as well as in the health-related MDGs. This finding is consistent with Dollar and Kraay (2002) who advocate that GDP growth is good for the poor. Our finding implies that growth-oriented policies will not only help raise income but also help narrow down MDG disparities. Promoting growth in poor countries will go a long way toward addressing the MDG disparity issue. Finally, it is found that for some MDGs, disparities within one or two subregions dominate the total, therefore, tackling regional disparity in these cases simply reduces to helping the poor countries in those particular subregions. Under such circumstances, it would be ineffective and inefficient to design or implement regionwide interventions.

A major limitation of this paper lies in shortage of data, which made it virtually impossible to conduct formal analysis of convergence or to use more advanced modeling techniques such as generalized method of moments (GMM), which can handle the endogeneity issues. Data shortage also prevented inclusion of some other important variables affecting the MDG levels or their disparities such as gender equity, infrastructure development, and status of social protection.

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### **About the Paper**

Guanghua Wan and Yuan Zhang provide estimates on the extent of disparities in the Millennium Development Goals, and depict their trends. More importantly, sources or causes of the disparities are quantified and policy implications are discussed.


### **About the Asian Development Bank**

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than \$2 a day, with 903 million struggling on less than \$1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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