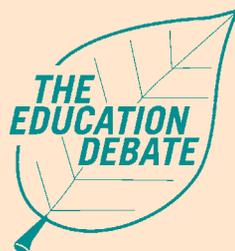


## BEYOND GENDER: MEASURING DISPARITY IN SOUTH ASIA USING AN EDUCATION PARITY INDEX

Friedrich Huebler



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# BEYOND GENDER: MEASURING DISPARITY IN SOUTH ASIA USING AN EDUCATION PARITY INDEX

Friedrich Huebler



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Regional Office for South Asia; and  
United Nations Girls' Education Initiative (UNGEI)  
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## SERIES FOREWORD

There is a growing sense of momentum around education in South Asia. Governments are engaged and a lot has been done. The Millennium Development Goals have added an additional spur to action as indeed have greater awareness on gender disparity and the need for educated workers. There is though a long way to go if the rights of all children are to be realized.

Providing access to education is only part of the story. Once children are enrolled and attending, the quality of their education must make it a worthwhile experience. The special needs of girls in the social and cultural context of South Asia call for special measures, as do the needs of all children in situations of conflict and emergency. South Asia has many rich, positive examples of success in advancing basic education. It is important that these are shared and built on if there is to be an overall improvement throughout the region.

This series of papers aimed at promoting better education in South Asia grew out of collaboration between the UNICEF Regional Office for South Asia and the newly formed UN Girls' Education Initiative, and had its genesis at a Regional Meeting on Accelerating Girls' Education in South Asia in February 2005.

Essentially the series is intended to be a forum that allows debate, exchange of ideas and to break new ground. It will aim to capture the momentum and extol good practice to all engaged in educational policy and implementation.

The series does not seek to represent a specific viewpoint, but rather is intended to enable specialist contributors to present issues in greater depth and breadth than is often the case in official documents.

Initially the series will focus on girls' education but it is hoped that eventually it will broaden into a platform for more general education issues related to South Asia, with a particular emphasis on social inclusion. Contributions and feedback are invited from academics and practitioners from throughout the South Asia region and beyond. The series editors are particularly interested in submissions which offer new ideas and strategies that can assist those needing answers, and which can add impetus to the ongoing efforts in the region to provide quality education for all.

**Come, join the debate!**

## ACKNOWLEDGEMENTS

This document is based on work the author presented at the conference on 'Education policy and the Right to Education: Towards More Equitable Outcomes for South Asia's Children' that was organized by the UNICEF Regional Office for South Asia in September 2007. I am grateful to Susan Durston, who encouraged me to study disparities in the education systems of South Asia. I would also like to thank the conference participants for their comments on my presentation. Finally, my thanks go to Xiaodong Cai and Tomoyo Sakiyama, who reviewed drafts of this paper, and to John Evans, who edited the publication.

Friedrich Huebler

## ACRONYMS

DHS	Demographic and Health Survey
ECCE	Early Childhood Care and Education
ECOSOC	Economic and Social Council
EDI	EFA Development Index
EFA	Education for All
EPI	Education Parity Index
GDI	Gender Development Index
GDP	Gross Domestic Product
GEEI	Gender Equality in Education Index
GEI	Gender-specific EFA Index
GER	Gross Enrolment Rate
GIR	Gross Intake Rate
GPI	Gender Parity Index
HDI	Human Development Index
IIPS	International Institute for Population Sciences
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
NAR	Net Attendance Rate
NER	Net Enrolment Rate
NIR	Net Intake Rate
UIS	UNESCO Institute for Statistics
UNDG	United Nations Development Group
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

## SUMMARY

Analysis of disparities in national education systems is often limited to gender although other dimensions of disparity may also be important. This paper presents data on disparity in primary and secondary education by gender, area of residence and household wealth for countries in South Asia. To facilitate the interpretation of complex data an Education Parity Index is introduced. The EPI combines information on disparities across different education indicators and across different groups of disaggregation. The EPI is flexible and can be modified according to national priorities. The use of the EPI as a tool to assess education disparities is illustrated with household survey data from Afghanistan, Bangladesh, India, Nepal and Pakistan.



## INTRODUCTION

Analysis of disparities in national education systems is often limited to gender although other dimensions of disparity may also be important. This paper provides an overview of disparity analysis in the area of education that looks beyond gender, with a focus on data from South Asia.

Chapter 2 describes basic concepts of disparity analysis and presents trend data on primary school participation of boys and girls in Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. The chapter closes with an overview of composite indicators of disparity.

Chapter 3 builds on the concepts outlined in Chapter 2 and introduces an Education Parity Index (EPI) that can be used to measure disparity across different education indicators and across different dimensions of disaggregation.

Chapter 4 applies the Education Parity Index to household survey data from five South Asian countries. The EPI and its components reveal how much disparity exists in each country's education system and whether disparity is greatest with regard to gender, area of residence or household wealth. A trend analysis describes how the level of disparity has evolved over the past decade.

Chapter 5 describes the advantages and disadvantages of the EPI and concludes the paper with a summary of the main findings.

## MEASUREMENT OF DISPARITY IN EDUCATION

### 2.1 Education Indicators

Various indicators have been used over the years to assess national education systems. Through the Education for All process and efforts related to the Millennium Development Goals, a core set of standardized indicators has emerged. For the monitoring of progress toward the Millennium Development Goals related to education, only four indicators are used (UN ECOSOC, 2007):

1. Primary school net enrolment rate
2. Survival rate to the last grade of primary school<sup>1</sup>
3. Literacy rate of 15- to 24-year-olds, male and female
4. Ratio of girls to boys in primary, secondary, and tertiary education.

The statistical tables in the annual publication *The State of the World's Children* by UNICEF (2007b) list data on school attendance at the primary and secondary level of education in addition to data on enrolment compiled by UNESCO. Net attendance rates are calculated from nationally representative household surveys, mainly the Multiple Indicator Cluster Surveys (MICS) by UNICEF and the Demographic and Health Surveys (DHS) that are carried out with support from the US Agency for International Development (USAID).<sup>2</sup> If there is no measurement error and if all children enrolled in school also attend, net enrolment rates are identical to net attendance rates.<sup>3</sup>

The MDG education indicators and the net attendance rates in *The State of the World's Children* meet the definition of a good indicator provided in the guide to *Gender-sensitive Education Statistics and Indicators* (UNESCO, 1999). Good indicators should be:

- 'policy-relevant, by being capable of providing clear and unambiguous responses to key policy issues and concerns;
- user friendly, i.e. comprehensible, timely and few in number;
- derived from a framework, which allows the interpretation of one figure (say enrolment) in the context of other basic variables (say demography and investment in education) of a particular country;
- technically sound, i.e. valid, reliable and comparable;
- feasible to measure at reasonable cost, in that the basic statistics required for deriving them can be either readily available or comparatively easy to collect within a well-defined time-frame' (UNESCO, 1999, p.6).

The annual *Education for All Global Monitoring Report* (UNESCO, 2007) contains statistics for a larger set of indicators, including:

- Gross enrolment rate in pre-primary education
- Net enrolment rate in pre-primary education
- New entrants to the first grade of primary education with early childhood care and education (ECCE) experience
- Gross intake rate in primary education
- Net intake rate in primary education
- Transition rate to secondary education
- School life expectancy
- Repetition rate by grade
- Dropout rate by grade
- Pupil:teacher ratio
- Percentage of trained teachers
- Adult literacy rate

Indicator definitions and calculation methods can be found in Annex 1 and in publications by UNESCO (1998) and the UNESCO Institute for Statistics (2003).

## 2.2 Disparity Analysis by Gender – Primary School Participation

The lack of available data is a common obstacle to the analysis of disparities in national education systems. Enrolment statistics in the *Global Education Digest*

(UNESCO Institute for Statistics, 2007) and the *EFA Global Monitoring Report* (UNESCO, 2007) are usually only disaggregated by gender.

Other disparities, for example by area of residence or by household wealth, can be studied with data from household surveys, including the Multiple Indicator Cluster Surveys (MICS) and the Demographic and Health Surveys (DHS).

This section describes primary school participation in the South Asia region, disaggregated by gender, using results compiled by UNICEF from a wide variety of sources.

The box at the end of this section presents data on primary school participation in the eight South Asian countries from 1980 to 2006: Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. The principal sources of data were several MICS and DHS surveys, two online databases by the UNESCO Institute for Statistics (UIS, 1999; 2008), and an EFA database (UNESCO, 2000).<sup>4</sup>

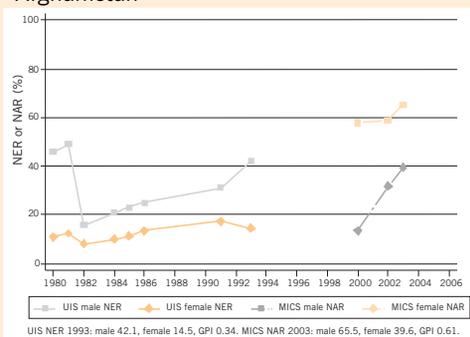
The graphs plot primary school net enrolment rates (NER) and net attendance rates (NAR). The primary school net enrolment rate and net attendance rate are two of the most basic indicators used to assess national education systems and yet the figures show that there are large gaps in data coverage. At the bottom of each graph, the gender parity index (GPI) for the most recent observation in each time series is listed. The GPI is the ratio of the female over the male NER or NAR.

- In **Afghanistan**, primary school participation by girls was very low until the late 1990s. Fewer than 20 per cent of all girls of primary school age were in school. Since 2000, primary school net attendance rates by girls have increased rapidly but are still below the respective values for boys.
- In **Bangladesh**, primary school net enrolment and net attendance rates have increased steadily since the late 1980s. In addition, girls reached the same level of primary school participation as boys around the year 2000 and since then female enrolment and attendance rates have been above male rates.
- In **Bhutan**, there has been a steady increase in primary school participation since 1990 and at the same time a reduction in the gap between boys and girls. The latest enrolment data shows that the country has reached gender parity in primary education.
- In **India**, data from a variety of sources shows high levels of primary school participation. Girls continue to lag behind boys but the gap is smaller than it was in previous years.

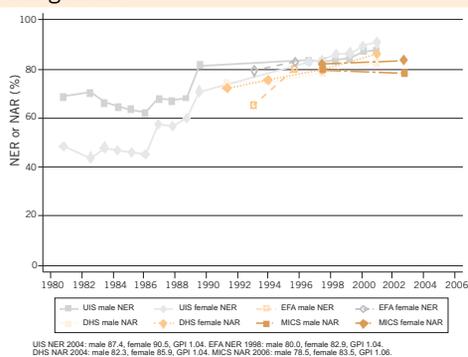
- The **Maldives** has been near universal primary education and gender parity since the late 1990s.
- In **Nepal**, there has been a remarkable increase in primary school attendance and enrolment by girls since the 1980s while boys' net enrolment and attendance rates have stayed at about the same level. The most recent DHS data from 2006 indicates that gender disparity has almost disappeared at the primary level of education.
- In **Pakistan**, data coverage is spotty and inconsistent, and no steady trend toward increased primary school participation can be observed. At the same time the data from the different sources confirms that gender disparity is a persistent problem, with fewer girls than boys in primary school.
- In **Sri Lanka**, there is also weak data coverage but the latest enrolment rates indicate that the Millennium Development Goals of universal primary education and gender parity have been reached.

### PRIMARY SCHOOL PARTICIPATION IN SOUTH ASIA, 1980–2006

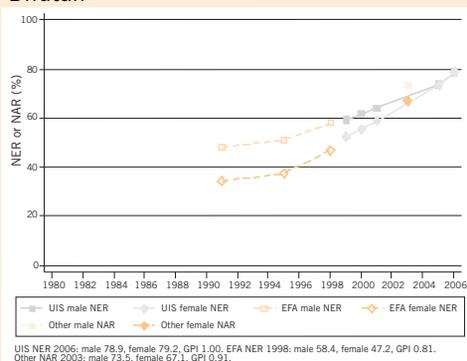
#### Afghanistan



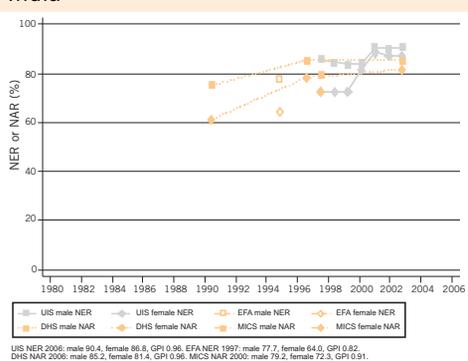
#### Bangladesh



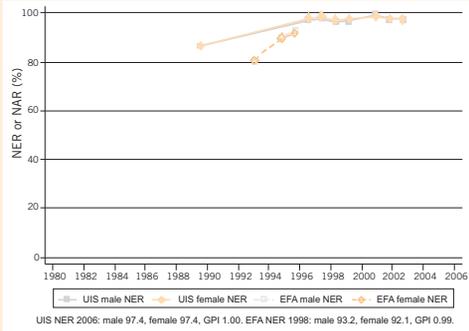
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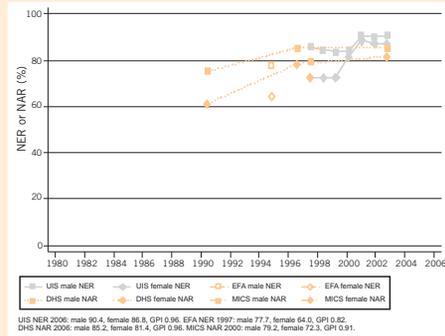
#### India



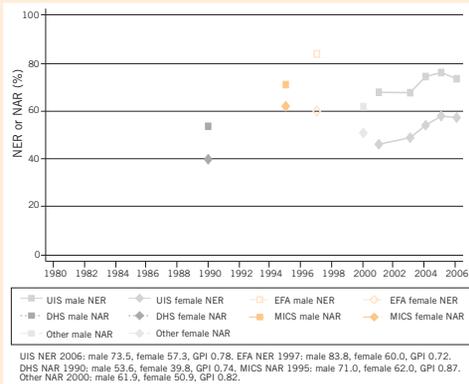
Maldives



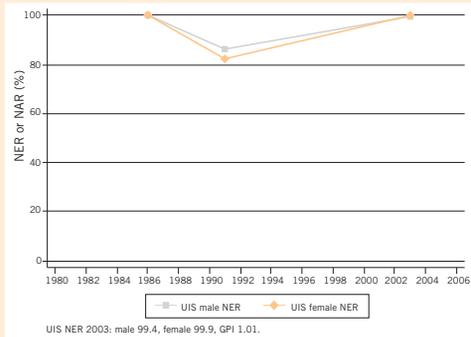
Nepal



Pakistan



Sri Lanka



2.3 Gender Parity Index

One of the most basic disparity indicators is the difference in primary school attendance between boys and girls.<sup>5</sup>

$$\text{Gender difference} = \text{PNAR}_{\text{male}} - \text{PNAR}_{\text{female}}$$

where  $\text{PNAR}_{\text{male}}$  is the male primary school net attendance rate and  $\text{PNAR}_{\text{female}}$  the female primary school net attendance rate.

A disadvantage of the difference between male and female attendance rates is that the result does not take the overall level of school attendance into account. For example, compare two extreme situations:

1. Gender difference = 100% – 90% = 10%
2. Gender difference = 15% – 5% = 10%

In both cases, the gender difference is 10%. However, in the first example, the relative gap between male and female attendance rates is much smaller than in the second example.

A more useful measure of disparity between boys' and girls' attendance rates is the Gender Parity Index (GPI), the ratio of female to male values.

$$\text{Gender Parity Index} = \frac{\text{Female primary school net attendance rate}}{\text{Male primary school net attendance rate}} = \frac{\text{PNAR}_{\text{female}}}{\text{PNAR}_{\text{male}}}$$

If the GPI is 1, the country is at gender parity.<sup>6</sup> A GPI above 1 indicates disparity in favour of girls and a GPI below 1 disparity in favour of boys. With the values from the previous examples, the GPI is calculated as follows:

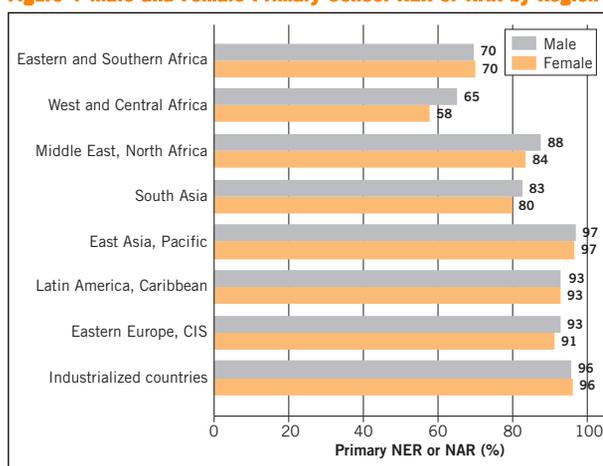
$$1. \text{ GPI} = \frac{90\%}{100\%} = 0.9$$

$$2. \text{ GPI} = \frac{5\%}{15\%} = 0.33$$

The difference between the male and female values is 10% in both cases but the GPI is either 0.9 or 0.33. In the case of the higher attendance rates, the country is much closer to gender parity – a GPI of 1 – than in the case of the lower attendance rates. As a measure of equality or inequality, the GPI is therefore more precise.

Figures 1 and 2 compare gender disparity in South Asia and in other regions.<sup>7</sup> Figure 1 displays the gender-disaggregated primary school net enrolment or net attendance rates by region. Overall participation rates are lowest in West and Central Africa, and in Eastern and Southern Africa. South Asia has the third-lowest enrolment and attendance rates, with a male NER or NAR of 83 per cent and a female NER or NAR of 80 per cent.

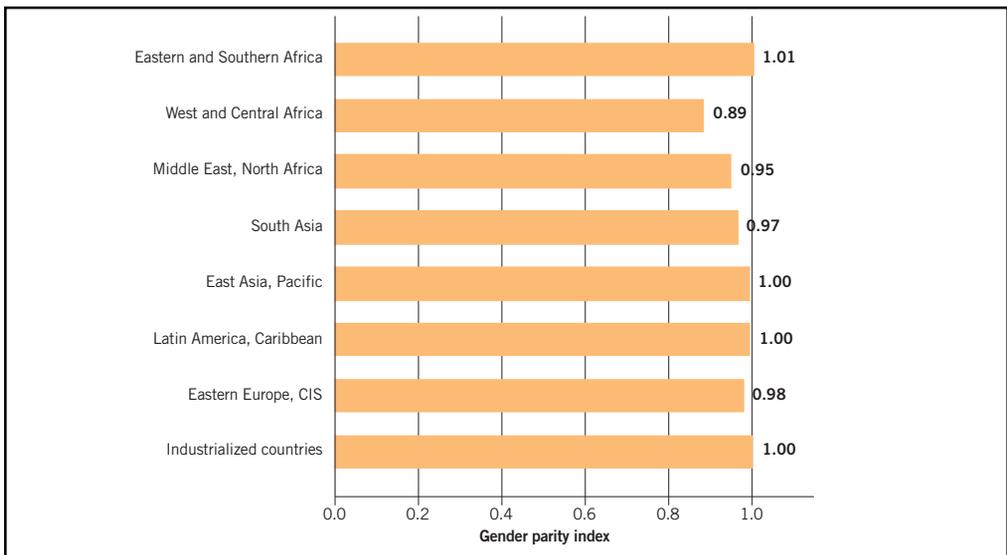
**Figure 1 Male and Female Primary School NER or NAR by Region**



Source: UNICEF (2007a)

Figure 2 shows the data from Figure 1 in terms of the Gender Parity Index. All regions except West and Central Africa are at or near gender parity in primary education. Eastern and Southern Africa has the highest value although, compared with most other regions, relatively few children are in primary school. Figure 2 makes it clear that the GPI alone provides only a partial picture of the participation of boys and girls in the education system.

**Figure 2 Gender Parity Index for Primary School NER or NAR by Region**



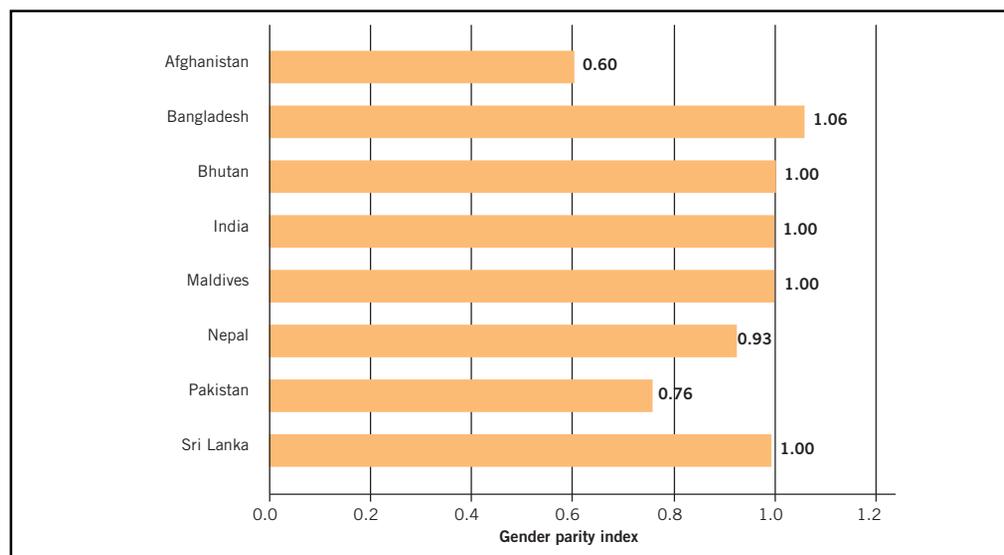
Source: UNICEF (2007a)

Lastly, Figure 3 displays the gender parity index for the primary school net enrolment or net attendance rate in the eight South Asian countries.<sup>8</sup> Bhutan, India, the Maldives and Sri Lanka have reached gender parity in primary education. Bangladesh is the only country with a gender disparity in favour of girls. In Afghanistan and Pakistan, girls are far behind boys with regard to primary school attendance or enrolment. In Nepal, girls are also less likely to be in school than boys but gender parity is within reach.

The concept of the gender parity index can be extended to other types of disaggregation, such as the area of residence or the level of household wealth.

To calculate an area of residence parity index, the rural primary school net attendance rate can be divided by the urban primary school net attendance rate:

**Figure 3 Gender Parity Index for Primary School NER or NAR, South Asia**



Source: UNICEF (2007a), UNESCO Institute for Statistics (2008)

$$\text{Area Parity Index} = \frac{\text{Rural primary school net attendance rate}}{\text{Urban primary school net attendance rate}} = \frac{\text{PNAR}_{\text{rural}}}{\text{PNAR}_{\text{urban}}}$$

Similarly, a parity index linked to household wealth can be calculated:<sup>9</sup>

$$\text{Wealth Parity Index} = \frac{\text{Poorest quintile primary school net attendance rate}}{\text{Richest quintile primary school net attendance rate}} = \frac{\text{PNAR}_{\text{w1}}}{\text{PNAR}_{\text{w5}}}$$

## 2.4 Composite Indicators of Disparity

A meaningful disparity index should be based on differences in participation by groups that are favoured or excluded from the education system. Typical differences are those observed between boys and girls, urban and rural residents, and children from rich and poor households. Indicators like the gender parity index focus attention on a single dimension of disparity and ignore other dimensions that can also be important, depending on the country context.

In a study of excluded girls, Lewis and Lockheed (2007) describe patterns of exclusion in different regions. For instance, in South Asia members of lower castes are often excluded, while in Latin America members of the indigenous population are

excluded. The authors proceed to compare the schooling of children from different groups. In India, the primary school enrolment rate of majority urban boys is highest while enrolment rates are lowest among rural girls from scheduled castes or tribes. In Bangladesh, household wealth is shown to be strongly linked to the highest grade attained.

To overcome the disadvantages of indices that examine only one dimension of disparity (for example gender) or one aspect of the education system (for example primary school attendance), several composite indicators have been proposed.

### **Gender-specific EFA Index (GEI)**

This index was developed by UNESCO for use in its reporting on the EFA goals. The GEI is the average of the gender parity indices for:

- Primary GER
- Secondary GER
- Adult literacy rate

If the GPI for one of the three components of the GEI is greater than 1 because female values are above male values, the usual calculation method (female divided by male value) is reversed and the respective male value is divided by the female value. This ensures that the GEI is limited to a range of 0 to 1.

### **EFA Development Index (EDI)**

The *Education for All Global Monitoring Reports* introduced the EFA Development Index (EDI), which combines data on four EFA indicators:

- Primary NER
- Adult literacy rate
- Survival rate to Grade 5
- Gender-specific EFA Index (GEI)

The EDI, confined to values between 0 and 1, is the arithmetic mean of these four values. Thus disparity as measured by the GEI accounts for only a quarter of the value of this index.

### **Gender Development Index (GDI)**

The Gender Development Index (GDI) is calculated by UNDP to reflect inequalities between men and women, based on the same data as the more widely known Human Development Index (HDI): life expectancy at birth, adult literacy rate and GDP per capita (UNDP, 2007).

### Gender Equality in Education Index (GEEI)

Unterhalter (2006) proposes an indicator to measure gender inequality in education. Her gender equality in education index (GEEI) combines data from four indicators:

- Primary school net attendance rate of girls
- Survival rate to Grade 5 of girls
- Secondary school net enrolment ratio of girls
- Gender Development Index (GDI)

One disadvantage of Unterhalter's GEEI is that it is not a true measure of inequality. Except for the GDI, the other three components only refer to data for girls. It is possible to have a high value for the GEEI if, for example, the survival rate to Grade 5 is 100% for girls and 0% for boys. By design, the indicator also ignores other dimensions of disparity, such as area of residence.

### Equity across geographic regions within a country

Equity across geographic regions within a country is addressed by Sherman and Poirier (2007). The authors study equity in access, measured by enrolment ratios, and equity in resource allocation, measured by expenditure per pupil and pupil:teacher ratios. Sherman and Poirier further distinguish between horizontal equity and equal educational opportunity. Horizontal equity refers to disparities in access and resource allocation across regions within a country. Equal educational opportunity refers to the links between access and resources on the one hand and wealth and residence in an urban or rural area on the other hand. The actual analysis is limited to regional disparities but the authors mention that disparities based on gender, race or ethnicity, and socio-economic status may be more important than regional disparities.

To measure equity in primary and secondary school enrolment between different regions, Sherman and Poirier employ two indicators:

- **Range ratio:** The range ratio is calculated by dividing the highest regional value by the lowest regional value for a given indicator. Equity is indicated by the value 1. Higher values indicate inequity.
- **Coefficient of variation:** The coefficient of variation is calculated by dividing the standard deviation of an indicator by its mean value. This coefficient measures the variability of an indicator around the mean value, where perfect equity is indicated by the value 0. Higher values indicate inequity.

A disadvantage of the range ratio is that its values are not bound by an upper limit. By reversing the calculation method and dividing the lowest by the highest regional value, the range would be limited to values between 0 and 1, similar to the EFA Development Index, with 1 indicating equity.

## EDUCATION PARITY INDEX

Chapter 2 introduced some basic concepts for the measurement of education disparity. The chapter also described existing inequality indicators and pointed out some of their weaknesses. Here, these concepts are applied to suggest a composite indicator that combines information on more than one dimension of disparity.

The proposed *Education Parity Index* or EPI measures disparity:

- a) across different groups of the population, for example boys and girls or urban and rural children, and
- b) across different indicators, for example school attendance or completion.

The EPI can be modified to include any number of groupings and indicators depending on the desired level of analysis and depending on the available data. This paper focuses on three groupings:

- Gender (female, male)
- Area of residence (rural, urban)
- Household wealth (poorest to richest quintile)

and three indicators:

- Primary school net attendance rate (PNAR)
- Secondary school net attendance rate (SNAR)
- Survival rate to the last grade of primary school (SRLG)

The underlying concept is that of the Gender Parity Index, modified to constrain the range to 0 to 1, where 1 indicates equality. This is accomplished by always dividing the lowest by the highest value. As an example, assume that the female primary NAR in a country is 75% and the male NAR 70%. The standard Gender Parity Index for the primary NAR would then be calculated as follows:

$$GPI = \frac{PNAR_{female}}{PNAR_{male}} = \frac{75\%}{70\%} = 1.07$$

where  $PNAR_{female}$  is the female primary school net attendance rate and  $PNAR_{male}$  the male primary school net attendance rate. For the EPI, to limit the range to values between 0 and 1, the smaller of the two values is always placed in the numerator and the larger value in the denominator:

$$\begin{aligned} EPI_{PNAR\ gender} &= \frac{\min(PNAR_{male}, PNAR_{female})}{\max(PNAR_{male}, PNAR_{female})} \\ &= \frac{\min(70\%, 75\%)}{\max(70\%, 75\%)} \\ &= \frac{70\%}{75\%} \\ &= 0.93 \end{aligned}$$

$EPI_{PNAR\ gender}$  is the Education Parity Index by gender for the primary school net attendance rate. The value 0.93 indicates that there is disparity in the education system (the value 1 would indicate parity), but to understand whether this disparity is to the disadvantage of boys or girls it is necessary to examine the underlying data, in this case the male and female primary NAR values.

Similar indices can be calculated by disaggregating the data by other dimensions, in this example area of residence and household wealth. The parity index for the primary NAR with regard to area of residence can be called  $EPI_{PNAR\ area}$  and the parity index for the primary NAR with regard to household wealth  $EPI_{PNAR\ wealth}$ .

The arithmetic mean of the three disparity indicators –  $EPI_{PNAR\ gender}$ ,  $EPI_{PNAR\ area}$  and  $EPI_{PNAR\ wealth}$  – indicates overall disparity in primary school attendance across the dimensions of gender, area of residence and wealth quintile:

$$EPI_{primary\ NAR} = \frac{EPI_{PNAR\ gender} + EPI_{PNAR\ area} + EPI_{PNAR\ wealth}}{3}$$

The EPI can be further expanded to include information on disparity in other areas of the education system. Here, we want to measure disparity for the following three indicators:

- Primary school net attendance rate (PNAR)
- Secondary school net attendance rate (SNAR)
- Survival rate to the last grade of primary school (SRLG)

The indices for the secondary school net attendance rate,  $EPI_{\text{secondary NAR}}$ , and for the survival rate to the last grade of primary school,  $EPI_{\text{survival rate}}$ , are, following the above procedure:

$$EPI_{\text{secondary NAR}} = \frac{EPI_{\text{SNAR gender}} + EPI_{\text{SNAR area}} + EPI_{\text{SNAR wealth}}}{3}$$

$$EPI_{\text{survival rate}} = \frac{EPI_{\text{SRLG gender}} + EPI_{\text{SRLG area}} + EPI_{\text{SRLG wealth}}}{3}$$

The overall EPI is then the average of the three individual parity indices:

$$EPI = \frac{EPI_{\text{primary NAR}} + EPI_{\text{secondary NAR}} + EPI_{\text{survival rate}}}{3}$$

The theoretical range of the EPI is 0 to 1, where 0 indicates absolute inequality. Such a value would be obtained if no girls, rural residents or poor children were in school. An EPI of 1 indicates absolute equality, with the same participation rates for all children.

For illustrative purposes, the calculation of the Education Parity Index is demonstrated with data from India in Annex 2.

If desired, the EPI can be modified to cover other education indicators and other groups of disaggregation. In Nepal and other countries in South Asia, for instance, caste and ethnicity are important determinants of exclusion from the education system (World Bank and DFID, 2006). Depending on the available data, a component measuring disparity between children from different castes or ethnic groups could be added to the EPI. The generalized formula that allows such a modification of the Education Parity Index is described in Annex 3.

## EDUCATION DISPARITY IN SOUTH ASIA

### 4.1 Results for South Asia

The Education Parity Index described in Chapter 3 can now be used to compare the countries in South Asia. For this analysis, household survey data was available for five of the eight countries in the region:

- Afghanistan MICS 2003
- Bangladesh MICS 2006
- India DHS 2005/06
- Nepal DHS 2006
- Pakistan Survey 2000/01

No survey data was available for Bhutan, the Maldives and Sri Lanka.

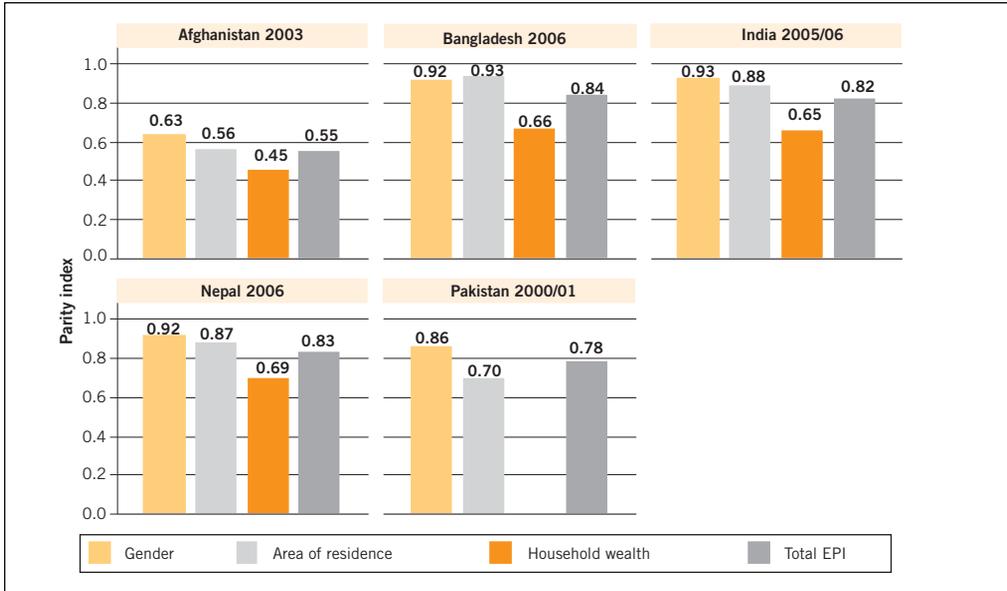
Table 1 lists disaggregated values for the primary school NAR, secondary school NAR and survival rate to the last grade of primary school in Afghanistan, Bangladesh, India, Nepal and Pakistan.<sup>10</sup> Using this data, the Education Parity Indices for gender, area of residence and household wealth for the three indicators can be calculated, together with an overall index for each country. The calculation method is described in Annex 2 and the resulting EPI values are shown in Table 2.

- In **Afghanistan**, gender disparity at the secondary level of education, indicated by the value 0.33, is much greater than at the primary level, where the gender parity index is 0.61 (see Table 2). On the other hand, there is hardly any gender disparity in the survival rate to the last grade, as indicated by the value 0.96. Disparity by household wealth is consistently greater than disparity by gender or area of residence. The biggest disparity exists for secondary school attendance of children from poor and rich households, as indicated by the value 0.20. The overall EPI is 0.55, which shows that the education system in Afghanistan is far from equality.
- In **Bangladesh**, disparity at the secondary level of education is greater than at the primary level, similar to Afghanistan. In addition, overall disparity linked to household wealth (0.66) is more important than disparity linked to gender (0.92) or the area of residence (0.93).
- In **India**, the parity index for the secondary school net attendance rate is 0.65 and the parity index for the survival rate to the last grade is 0.95. The biggest disparity across the three indicators and across the three categories of disaggregation is observed for secondary school attendance by household wealth. The value 0.35 means that the secondary school NAR among children from the poorest wealth quintile is two-thirds lower than the secondary school NAR among children from the richest quintile.
- In **Nepal**, similar disparities as in India are observed. Again, there is greater disparity linked to the secondary NAR and to household wealth than to other indicators and levels of disaggregation.
- In **Pakistan**, gender disparity is less significant than disparity by area of residence. The survey data for Pakistan contains no information on household wealth.

Figure 4 provides an overview of the parity indices from Afghanistan, Bangladesh, India, Nepal and Pakistan. At a value of 1 there is parity while lower values indicate disparity. In each country with data, disparity by wealth is greatest, as indicated by the low value of the wealth parity index. In Afghanistan, India, Nepal and Pakistan, gender disparity is smaller than disparity linked to the area of residence and household wealth. The exception is Bangladesh, where the disparity between urban and rural areas is smaller than the disparities linked to other groups of disaggregation.

Overall disparity, measured by the total Education Parity Index, the rightmost bar in Figure 4, is at roughly the same level in Bangladesh, India, Nepal and Pakistan. The

**Figure 4 Education Disparity in South Asia**



approximate EPI value 0.8 means that the primary NAR, the secondary NAR, and the survival rate to the last grade of the most disadvantaged groups are, on average, at 80% of the respective attendance and survival rates of the groups with the highest values in each country. The worst performing country in terms of disparity is Afghanistan, with an EPI value of 0.55.

It is important to recall that the EPI only tells us whether there is disparity in the education system and as such it can be used to compare the degree of disparity in different countries. However, the value itself conveys no information on which group suffers from exclusion and therefore the EPI alone cannot be used to draft policy responses to reduce disparities. To identify disadvantaged groups it is necessary to review the underlying data in Table 1.

A further limitation of the EPI is that it does not take the absolute level of primary school attendance or other indicators into account. With the calculation method described in this paper, countries with a primary NAR of 90% could have the same parity index as countries with a primary NAR of 10%, as long as all groups of disaggregation participate equally in the education system.

**Table 1 Survey Data for South Asia**

<b>Afghanistan 2003</b>			
	<b>Primary NAR (%)</b>	<b>Secondary NAR (%)</b>	<b>Survival to last grade of primary (%)*</b>
Male	65.5	17.6	62.7
Female	39.6	5.8	60.0
Urban	72.1	22.7	71.0
Rural	45.8	6.7	53.2
Poorest quintile	39.3	5.2	51.3
Second quintile	44.8	5.0	44.9
Middle quintile	53.6	8.4	55.6
Fourth quintile	59.0	14.2	62.0
Richest quintile	71.5	25.3	75.9
<b>Bangladesh 2006</b>			
	<b>Primary NAR (%)</b>	<b>Secondary NAR (%)</b>	<b>Survival to last grade of primary (%)*</b>
Male	78.5	36.1	86.7
Female	83.5	41.3	93.2
Urban	80.6	44.4	91.0
Rural	81.1	36.4	89.8
Poorest quintile	73.0	18.8	79.8
Second quintile	80.2	28.9	86.1
Middle quintile	82.5	36.5	90.8
Fourth quintile	86.5	47.4	94.0
Richest quintile	86.8	59.9	95.8
<b>India 2005/06</b>			
	<b>Primary NAR (%)</b>	<b>Secondary NAR (%)</b>	<b>Survival to last grade of primary (%)*</b>
Male	85.2	58.5	95.7
Female	81.4	48.7	94.9
Urban	88.5	64.2	97.4
Rural	81.5	49.1	94.2
Poorest quintile	69.4	29.1	87.2
Second quintile	81.2	42.6	92.8
Middle quintile	87.5	52.1	95.5
Fourth quintile	92.2	65.5	98.0
Richest quintile	95.7	82.6	99.4

<b>Nepal 2006</b>			
	<b>Primary NAR (%)</b>	<b>Secondary NAR (%)</b>	<b>Survival to last grade of primary (%)*</b>
Male	86.0	45.7	89.0
Female	82.0	37.8	87.1
Urban	90.2	52.4	92.8
Rural	83.2	40.1	87.0
Poorest quintile	76.7	27.8	78.1
Second quintile	79.8	33.3	80.3
Middle quintile	84.3	40.6	89.3
Fourth quintile	86.9	50.8	92.5
Richest quintile	96.9	59.5	95.8
<b>Pakistan 2000/01**</b>			
	<b>Primary NAR (%)</b>	<b>Secondary NAR (%)</b>	<b>Survival to last grade of primary (%)*</b>
Male	61.9	23.2	89.9
Female	50.9	18.0	90.5
Urban	72.0	32.1	93.8
Rural	50.1	14.8	87.4
Poorest quintile			
Second quintile			
Middle quintile			
Fourth quintile			
Richest quintile			

\* Measured by a proxy indicator

\*\* The survey data for Pakistan contains no information on household wealth

**Table 2 Education Parity Indices for South Asia (calculated from values in Table 1)**

<b>Afghanistan 2003</b>				
	<b>Primary NAR</b>	<b>Secondary NAR</b>	<b>Survival to last grade of primary*</b>	<b>Total</b>
Gender	0.61	0.33	0.96	<b>0.63</b>
Area of residence	0.64	0.30	0.75	<b>0.56</b>
Household wealth	0.55	0.20	0.59	<b>0.45</b>
<b>Total</b>	<b>0.60</b>	<b>0.27</b>	<b>0.77</b>	<b>0.55</b>
<b>Bangladesh 2006</b>				
	<b>Primary NAR</b>	<b>Secondary NAR</b>	<b>Survival to last grade of primary*</b>	<b>Total</b>
Gender	0.94	0.88	0.93	<b>0.92</b>
Area of residence	0.99	0.82	0.99	<b>0.93</b>
Household wealth	0.84	0.31	0.83	<b>0.66</b>
<b>Total</b>	<b>0.93</b>	<b>0.67</b>	<b>0.92</b>	<b>0.84</b>
<b>India 2005/06</b>				
	<b>Primary NAR</b>	<b>Secondary NAR</b>	<b>Survival to last grade of primary*</b>	<b>Total</b>
Gender	0.96	0.83	0.99	<b>0.93</b>
Area of residence	0.92	0.77	0.97	<b>0.88</b>
Household wealth	0.73	0.35	0.88	<b>0.65</b>
<b>Total</b>	<b>0.87</b>	<b>0.65</b>	<b>0.95</b>	<b>0.82</b>
<b>Nepal 2006</b>				
	<b>Primary NAR</b>	<b>Secondary NAR</b>	<b>Survival to last grade of primary*</b>	<b>Total</b>
Gender	0.95	0.83	0.98	<b>0.92</b>
Area of residence	0.92	0.76	0.94	<b>0.87</b>
Household wealth	0.79	0.47	0.82	<b>0.69</b>
<b>Total</b>	<b>0.89</b>	<b>0.69</b>	<b>0.91</b>	<b>0.83</b>
<b>Pakistan 2000/01</b>				
	<b>Primary NAR</b>	<b>Secondary NAR</b>	<b>Survival to last grade of primary*</b>	<b>Total</b>
Gender	0.82	0.78	0.99	<b>0.86</b>
Area of residence	0.70	0.46	0.93	<b>0.70</b>
Household wealth	–	–	–	–
<b>Total</b>	<b>0.76</b>	<b>0.62</b>	<b>0.96</b>	<b>0.78</b>

\* Measured by a proxy indicator

## 4.2 Education Disparity Trends in South Asia

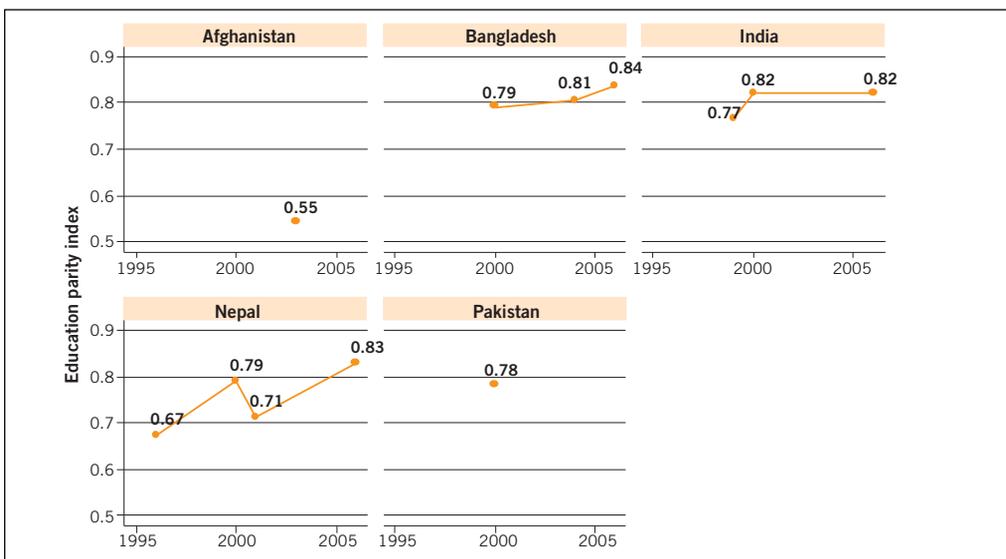
Through a combination of survey data from several years it is possible to analyse trends in disparity as measured by the Education Parity Index. For the trend analysis, the following household surveys were available in addition to those listed above:

- Bangladesh DHS 1999/2000
- Bangladesh DHS 2004
- India DHS 1998/99
- India MICS 2000
- Nepal DHS 1996
- Nepal MICS 2000
- Nepal DHS 2001

Figure 5 plots the EPI values calculated from each survey. Due to lack of data, no trends can be shown for Afghanistan and Pakistan. In the other three countries, the EPI has increased from the earliest to the latest year with data, indicating a decrease in disparity over the period of observation.

In Bangladesh, the EPI grew from 0.79 in 2000 to 0.84 in 2006. In India, the EPI was at 0.77 in 1999 and 0.82 in 2006. In Nepal, the EPI shows the biggest increase, from 0.67 in 1996 to 0.83 in 2006, interrupted by a decrease from 2000 to 2001. Compared with the other countries, Nepal has thus made the most progress toward parity in the education system.

**Figure 5 Education Disparity Trends in South Asia, 1996–2006**



Source: National household survey data, 1996–2006

The data gaps in Figure 5 bring to attention one limitation of the EPI. The net enrolment rate and other data published annually by UNESCO in the *Global Education Digest* or the *EFA Global Monitoring Report* is not disaggregated beyond gender and can therefore not be used to calculate the EPI. On the other hand, national household survey data, which permits the required level of disaggregation, is not collected every year but only every four or five years, on average.<sup>11</sup>

## CONCLUSION

Analysis of disparity in national education systems is often limited to a small number of indicators and to few dimensions of disparity, mainly gender. The Education Parity Index introduced in this paper tries to overcome this limitation by combining information on disparities across different aspects of the education system, such as access and completion, and across different groups of disaggregation, such as gender, area of residence and household wealth.

The EPI offers several advantages. It meets the requirements of a good indicator because it is policy-relevant, user friendly and technically sound, it can be interpreted in the context of other variables, and it can be readily calculated from household survey data. In addition, the EPI is flexible and can be modified to include dimensions of disparity that are important in a national context, such as caste and ethnicity. The EPI can also be expanded to cover different aspects of the education system, such as literacy or access to pre-primary education.

The adaptability of the index means that EPI values for different countries do not necessarily describe the same disparities. Because of its design, the EPI is simply an overall measure of disparity. Nevertheless, the EPI is useful for comparisons across countries as long as the indicators and groupings included in its calculation for a particular country cover that country's main disparities. If an important disparity is excluded from the calculation – for example, if a country does not recognize differences due to caste – then the EPI cannot be fully comprehensive and becomes less meaningful as a measure of disparity.

The EPI has other limitations. Because it relies on detailed household survey data, which is not collected on an annual basis, the EPI can only be used to track the evolution of disparities over longer time periods. In addition, the EPI only reveals whether disparity exists in a country; to identify the disadvantaged groups it is necessary to study the underlying data. Knowledge of the data used to calculate the EPI is also necessary because the absolute level of participation in the education system can be high or low in different countries, although their EPI values may be similar.

In spite of these limitations, the EPI is a useful tool that allows analysts and policy makers to assess and compare the level of disparity in different countries with a single, easy to interpret indicator. For South Asia, the analysis reveals that disparity linked to area of residence and household wealth is more important than disparity linked to gender. The analysis also shows that overall disparity, as measured by the EPI, has decreased in all countries with trend data over the past decade, bringing them closer to the goal of education for all.

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## NOTES

- <sup>1</sup> The survival rate to the last grade of primary school has replaced the survival rate to Grade 5 that served as an official indicator for monitoring progress toward MDG 2, Universal Primary Education, until 2007 (UNDG, 2003).
- <sup>2</sup> MICS data is available at [www.childinfo.org](http://www.childinfo.org), DHS data at [www.measuredhs.com](http://www.measuredhs.com).
- <sup>3</sup> Definitions for these and other education indicators are listed in Annex 1.
- <sup>4</sup> The 1999 database by UIS only contains historical data up to 1997. The newer UIS database covers the years since 1999 and is continuously updated with the most recent statistics. The separate EFA database was discontinued by UNESCO after 1998.
- <sup>5</sup> The discussion in this section can also be applied to enrolment rates. However, much of the analysis in this paper is based on household survey data and the concepts are therefore introduced with data on attendance, not enrolment.
- <sup>6</sup> For practical purposes, any GPI between 0.96 and 1.04 is usually considered gender parity.
- <sup>7</sup> The regional data is drawn from UNICEF (2007a), which combines data on enrolment published by UNESCO and data on attendance from household surveys.
- <sup>8</sup> The data for seven of the eight countries is from UNICEF (2007a). The data for Bhutan is from the UNESCO Institute for Statistics (2008).
- <sup>9</sup> In DHS and MICS surveys, household wealth is measured with an asset index as an indicator of relative wealth, using a methodology described by Filmer and Pritchett (2001). With the wealth index, all households are ranked from poorest to richest and then divided into quintiles of equal size.
- <sup>10</sup> Because of data limitations, this paper makes use of a proxy indicator for the survival rate to the last grade. The proxy indicator is the share of 15- to 17-year-old children that ever attended school, with at least  $n - 1$  years of education, where  $n$  is the number of grades of primary school.
- <sup>11</sup> The first three rounds of MICS surveys by UNICEF were conducted five years apart – 1995, 2000 and 2005 – but there are plans to move the MICS to a three-year cycle.
- <sup>12</sup> The definitions were adapted from UNESCO (2007) and UNESCO Institute for Statistics (2007).
- <sup>13</sup> The datasets from the India DHS can be obtained at the MEASURE DHS website, [www.measuredhs.com](http://www.measuredhs.com).

# ANNEX 1

## Indicator Definitions<sup>12</sup>

*Adult literacy rate:* Number of literate persons aged 15 years and above, expressed as a percentage of the total population in that age group.

*Dropout rate by grade:* Percentage of pupils who drop out from a given grade in a given school year.

*Gender parity index (GPI):* Ratio of female to male values of a given indicator. A GPI of 1 indicates parity between sexes. A GPI above or below 1 indicates a disparity in favour of one sex over the other.

*Gross enrolment rate (GER):* Number of pupils enrolled in a given level of education, regardless of age, expressed as a percentage of the population in the theoretical age group for the same level of education.

*Gross intake rate (GIR) in primary education:* Total number of new entrants to the first grade of primary education, regardless of age, expressed as a percentage of the population of theoretical entrance age to primary education.

*Net attendance rate (NAR):* The standard definition of the NAR is 'Number of pupils in the official age group for a given level of education who attend school in that level, expressed as a percentage of the population in that age group' (UNESCO, 2007, p.350). UNICEF uses a modified definition of the NAR that also considers children who are attending higher levels of education (UNICEF, 2007b, p.133). The modified primary NAR is the percentage of children of primary school age that are attending primary or secondary school. The standard definition of the primary NAR excludes

children in secondary school and may thus underestimate the actual level of participation in the education system. The modified secondary NAR is the percentage of children of secondary school age that are attending secondary school or higher.

*Net enrolment rate (NER):* Number of pupils in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group.

*Net intake rate (NIR):* New entrants to the first grade of primary education who are of the official primary school entrance age, expressed as a percentage of the population of that age.

*New entrants to primary education with ECCE experience:* Number of new entrants to primary education who have attended some form of organized early childhood care and education (ECCE) programmes, expressed as a percentage of the total number of new entrants to primary education.

*Percentage of trained teachers:* Number of teachers who have received the minimum organized teacher training (pre-service or in service) required for teaching at the relevant level of education in a country, expressed as a percentage of the total number of teachers at the given level of education.

*Pupil:teacher ratio:* Average number of pupils per teacher at a specific level of education, based on headcounts for both pupils and teachers.

*Repetition rate by grade:* Number of pupils who are enrolled in the same grade as the previous year, expressed as a percentage of the total enrolment in the given grade of education.

*School life expectancy:* Number of years a child of school entrance age is expected to spend at school or university, including years spent on repetition. School life expectancy can be calculated as the sum of the age-specific enrolment rates for primary, secondary, post-secondary non-tertiary, and tertiary education.

*Survival rate to grade n:* Percentage of a cohort of pupils enrolled in the first grade of a given level of education in a given school year who are expected to reach a given grade (*n*). Survival rates are calculated on the basis of the reconstructed cohort method, which uses data on enrolment and repeaters for two consecutive years.

*Transition rate to secondary education:* Number of new entrants to the first grade of secondary education in a given year, expressed as a percentage of the number of pupils enrolled in the final grade of primary education in the previous year.

*Youth literacy rate:* Number of literate persons aged 15 to 24 years, expressed as a percentage of the total population in that age group.

## ANNEX 2

### Calculating the EPI – The Example of India

This example uses India to demonstrate the calculation of the Education Parity Index. The data is from a Demographic and Health Survey that was carried out in India in 2005/06 (IIPS and Macro International, 2007a,b).<sup>13</sup> With the DHS data, values for the following indicators can be calculated:

- Primary school net attendance rate, disaggregated by gender, area of residence and household wealth.
- Secondary school net attendance rate, disaggregated by gender, area of residence and household wealth.
- Survival rate to the last grade of primary school, disaggregated by gender, area of residence and household wealth.

The indicator estimates from the India DHS are summarized in Table A1. (See also Table 1 in Chapter 4.)

**Table A1 Education in India, 2005/06**

India 2005/06			
	Primary NAR (%)	Secondary NAR (%)	Survival to last grade of primary (%)*
Male	85.2	58.5	95.7
Female	81.4	48.7	94.9
Urban	88.5	64.2	97.4
Rural	81.5	49.1	94.2
Poorest quintile	69.4	29.1	87.2
Second quintile	81.2	42.6	92.8
Middle quintile	87.5	52.1	95.5
Fourth quintile	92.2	65.5	98.0
Richest quintile	95.7	82.6	99.4

\* Measured by a proxy indicator (see Chapter 4)

The first step is to calculate the parity indices for each education indicator and for each of the groups of disaggregation, using the data from Table A1. The parity index for the primary school NAR by gender is:

$$\begin{aligned} \text{EPI}_{\text{PNAR gender}} &= \frac{\min(\text{PNAR}_{\text{male}}, \text{PNAR}_{\text{female}})}{\max(\text{PNAR}_{\text{male}}, \text{PNAR}_{\text{female}})} \\ &= \frac{\min(85.2\%, 81.4\%)}{\max(85.2\%, 81.4\%)} \\ &= \frac{81.4\%}{85.2\%} \\ &= 0.96 \end{aligned}$$

The parity index for the primary school NAR by area of residence is:

$$\begin{aligned} \text{EPI}_{\text{PNAR area}} &= \frac{\min(\text{PNAR}_{\text{urban}}, \text{PNAR}_{\text{rural}})}{\max(\text{PNAR}_{\text{urban}}, \text{PNAR}_{\text{rural}})} \\ &= \frac{\min(88.5\%, 81.5\%)}{\max(88.5\%, 81.5\%)} \\ &= \frac{81.5\%}{88.5\%} \\ &= 0.92 \end{aligned}$$

The parity index for the primary school NAR by household wealth quintile is:

$$\begin{aligned} \text{EPI}_{\text{PNAR wealth}} &= \frac{\min(\text{PNAR}_{w1}, \text{PNAR}_{w2}, \text{PNAR}_{w3}, \text{PNAR}_{w4}, \text{PNAR}_{w5})}{\max(\text{PNAR}_{w1}, \text{PNAR}_{w2}, \text{PNAR}_{w3}, \text{PNAR}_{w4}, \text{PNAR}_{w5})} \\ &= \frac{\min(69.4\%, 81.2\%, 87.5\%, 92.2\%, 95.7\%)}{\max(69.4\%, 81.2\%, 87.5\%, 92.2\%, 95.7\%)} \\ &= \frac{69.4\%}{95.7\%} \\ &= 0.73 \end{aligned}$$

A comparison of the three EPI values above shows that disparity in primary school attendance is greatest with regard to household wealth, with a value of 0.73. With regard to gender, the value 0.96 shows that there is little difference in primary school attendance between boys and girls.

The overall parity index for the primary school net attendance rate,  $EPI_{\text{primary NAR}}$ , is the mean value of the three parity indices for gender, area of residence and household wealth:

$$\begin{aligned} EPI_{\text{primary NAR}} &= \frac{EPI_{\text{PNAR gender}} + EPI_{\text{PNAR area}} + EPI_{\text{PNAR wealth}}}{3} \\ &= \frac{0.96 + 0.92 + 0.73}{3} \\ &= \frac{2.61}{3} \\ &= 0.87 \end{aligned}$$

The value 0.87 means that, on average across the three dimensions of gender, area of residence and household wealth, the primary school net attendance rate of the most disadvantaged group is 13% below the group with the highest net attendance rate.

By repeating the calculation for the secondary school net attendance rate and the survival rate to the last grade of primary school, Table A2 can be generated. (See also Table 2 in Chapter 4.)

**Table A2 Education Parity Index, India, 2005/06**

India 2005/06				
	Primary NAR	Secondary NAR	Survival rate to last grade of primary*	Total
Gender	0.96	0.83	0.99	<b>0.93</b>
Area of residence	0.92	0.77	0.97	<b>0.88</b>
Household wealth	0.73	0.35	0.88	<b>0.65</b>
Total	<b>0.87</b>	<b>0.65</b>	<b>0.95</b>	<b>0.82</b>

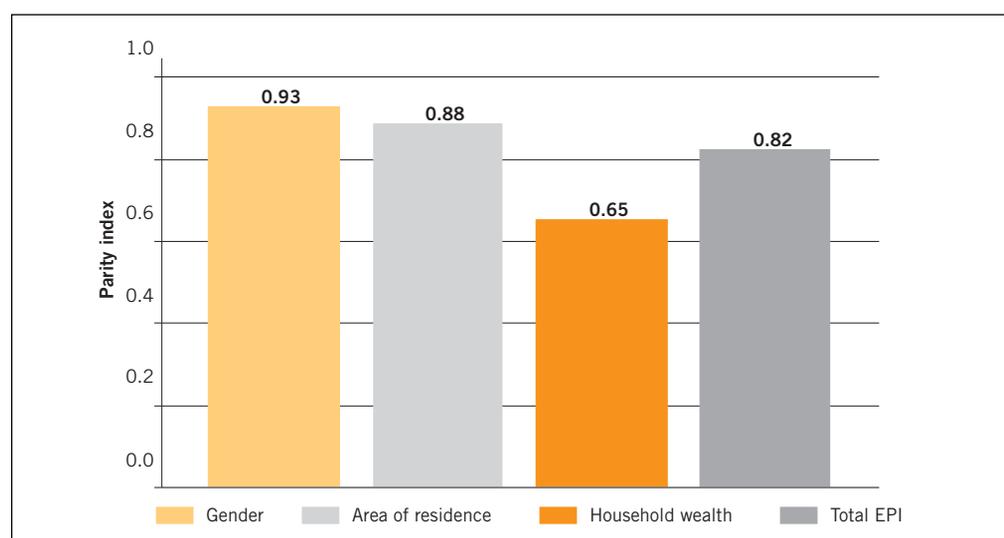
\* Measured by a proxy indicator (see Chapter 4)

The parity index for the secondary school net attendance rate is 0.65 and the parity index for the survival rate to the last grade is 0.95. The biggest disparity across the three indicators and across the three categories of disaggregation is observed for secondary school attendance by household wealth. The value 0.35 means that the secondary school NAR among children from the poorest wealth quintile is two-thirds lower than the secondary school NAR among children from the richest quintile. The last column in Table A2 lists disparity by gender, area of residence and household wealth across the three education variables under investigation.

The value 0.82 in the lower right corner of Table A2 is the overall Education Parity Index. The table shows that the EPI can be calculated in two ways: (a) as the average of the three parity indices for primary NAR, secondary NAR and the survival rate to the last grade of primary school; and (b) as the average of the respective indices for gender, area of residence and household wealth. The value 0.82 means that the primary NAR, secondary NAR and the survival rate are – across the dimensions of gender, area of residence and wealth – on average 18% lower for the most disadvantaged groups compared with the groups with the highest values.

The Education Parity Index can also be presented in graphical format, as shown in Figure A1. Here, the total EPI is displayed as the average of the parity indices for gender, area of residence and household wealth.

**Figure A1 Education Disparity in India, 2005/06**



## ANNEX 3

### Calculation of the Generalized Education Parity Index

The formula for the Education Parity Index can be generalized as follows:

$$\begin{aligned}
 \text{EPI} &= \frac{\text{EPI}_1 + \text{EPI}_2 + \dots + \text{EPI}_n}{n} \\
 &= \frac{1}{n} (\text{EPI}_1 + \text{EPI}_2 + \dots + \text{EPI}_n) \quad (1) \\
 &= \frac{1}{n} \sum_{i=1}^n \text{EPI}_i
 \end{aligned}$$

where  $n$  is the number of education indicators, for example primary NAR, secondary NAR and the survival rate to the last grade of primary school. For each indicator, a separate parity index  $\text{EPI}_i$  is calculated:

$$\begin{aligned}
 \text{EPI}_i &= \frac{\text{EPI}_{i1} + \text{EPI}_{i2} + \dots + \text{EPI}_{im}}{m} \\
 &= \frac{1}{m} (\text{EPI}_{i1} + \text{EPI}_{i2} + \dots + \text{EPI}_{im}) \quad (2)
 \end{aligned}$$

In (2),  $m$  is the number of groups of disaggregation, for example gender, area of residence and household wealth. Each  $\text{EPI}_{im}$  is the ratio of two indicator values, with the lowest value placed in the numerator and the highest value in the denominator:

$$\text{EPI}_{im} = \frac{\min\{x_{im1}, \dots, x_{imk}\}}{\max\{x_{im1}, \dots, x_{imk}\}} \quad (3)$$

$\{x_{im1}, \dots, x_{imk}\}$  is the set of disaggregated indicator values, for example the primary school net attendance rate by gender, or the secondary school net attendance rate by wealth quintile.  $k$  is the number of values within each group of disaggregation  $m$ . Note that  $k$  is not constant; for example,  $k = 2$  in the case of gender (male and female) and area of residence (urban and rural), and  $k = 5$  in the case of household wealth quintiles.

Substituting (3) into (2) yields:

$$\begin{aligned} \text{EPI}_i &= \frac{1}{m} \left( \frac{\min\{x_{i11}, \dots, x_{i1k}\}}{\max\{x_{i11}, \dots, x_{i1k}\}} + \frac{\min\{x_{i21}, \dots, x_{i2k}\}}{\max\{x_{i21}, \dots, x_{i2k}\}} + \dots + \frac{\min\{x_{im1}, \dots, x_{imk}\}}{\max\{x_{im1}, \dots, x_{imk}\}} \right) \\ &= \frac{1}{m} \sum_{j=1}^m \frac{\min\{x_{ij1}, \dots, x_{ijk}\}}{\max\{x_{ij1}, \dots, x_{ijk}\}} \end{aligned} \quad (4)$$

Combining equations (1) and (4) yields:

$$\text{EPI} = \frac{1}{n} \sum_{i=1}^n \frac{1}{m} \sum_{j=1}^m \frac{\min\{x_{ij1}, \dots, x_{ijk}\}}{\max\{x_{ij1}, \dots, x_{ijk}\}} \quad (5)$$

The expression can be simplified further by substituting  $X_{ij}$  for  $\{x_{ij1}, \dots, x_{ijk}\}$ :

$$\text{EPI} = \frac{1}{n} \sum_{i=1}^n \frac{1}{m} \sum_{j=1}^m \frac{\min(X_{ij})}{\max(X_{ij})} \quad (6)$$

In (6),  $n$  is the number of indicators,  $m$  is the number of groups of disaggregation, and  $X_{ij}$  is the set of indicator values  $x_{ijk}$  within each group of disaggregation.



## ABOUT THE AUTHOR

Friedrich Huebler is a Statistics and Monitoring Officer in the Division of Policy and Practice of UNICEF in New York. He specializes in the analysis of household survey data, with an emphasis on education, child labour and the Millennium Development Goals. Friedrich holds an MA in Business Studies and Economics from the University of Bremen and a PhD in Economics from the New School for Social Research in New York.



