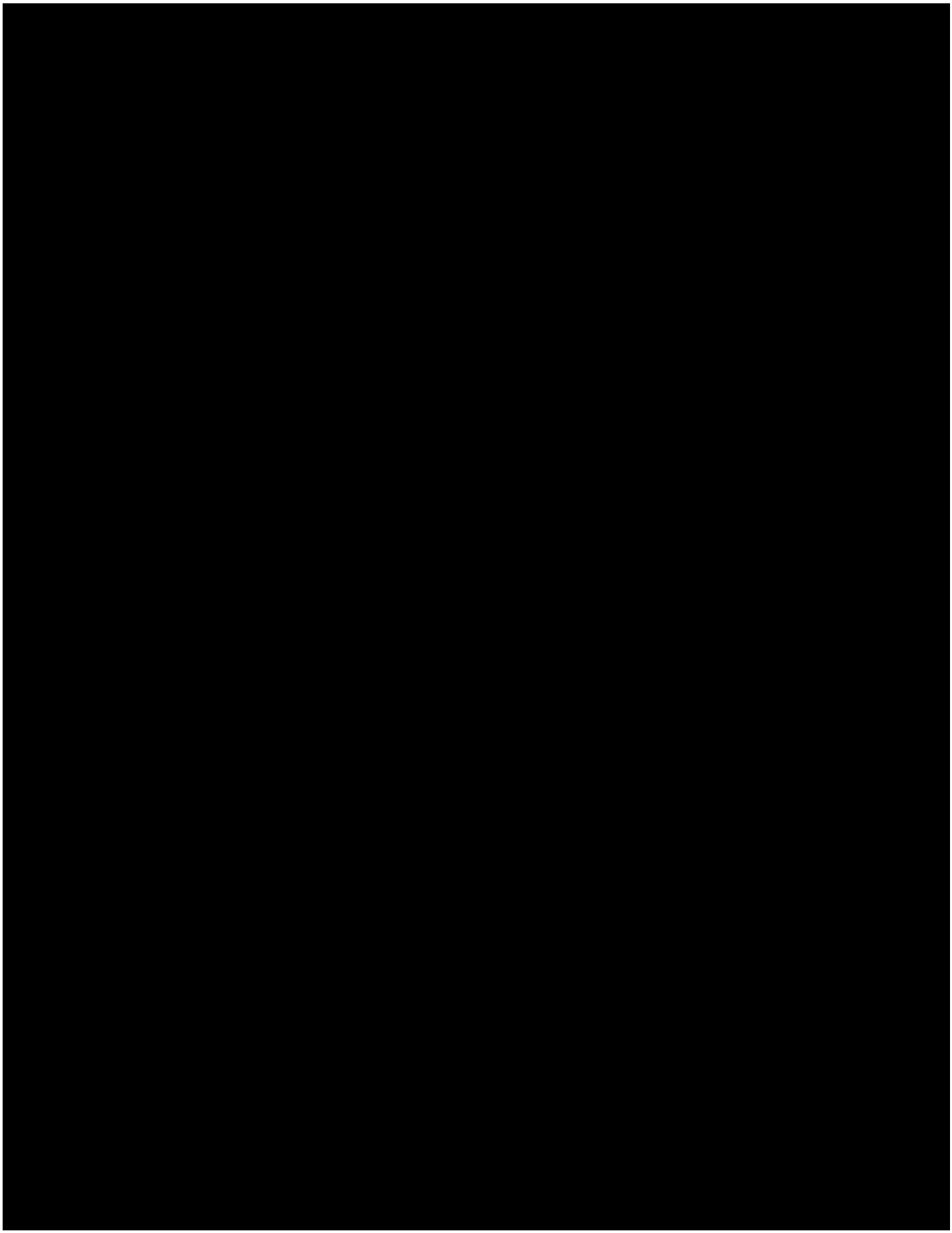


 WP/16/21

IMF Working Paper

Research Department and Strategy, Policy, and Review Department

Trends in Gender Equality and Women's Advancement*

Prepared by Janet G. Stotsky, Sakina Shibuya, Lisa Kolovich, and Suhaib Kebhaj

Authorized for distribution by Prakash Loungani and Catherine Pattillo

February 2016

Abstract

This paper examines trends in indicators of gender equality and women's development, using evidence derived from individual indicators and gender equality indices. We extend both the United Nations Development Program's Gender Development Index and Gender Inequality Index to examine time trends. In recent decades, the world has moved closer to gender equality and narrowed gaps in education, health, and economic and political opportunity; however, substantial differences remain, especially in South Asia, the Middle East, and sub-Saharan Africa. The results suggest countries can make meaningful improvements in gender equality, even while significant income differences between countries remain.

JEL Classification Numbers: I3, J1, J16

Keywords: Economics of gender, gender indicators and indices

Authors' E-Mail Addresses: jstotsky@imf.org; sshibuya@imf.org; lkolovich@imf.org; skebhaj@imf.org

* We are grateful to Mark Blackden, Diane Elson, Stephan Klasen, Jenny Lah and IMF colleagues, Andy Berg, Nen Gang, La-Bhus Fah Jirasavetakul, Kalpana Kochhar, Pritha Mitra, Monique Newiak, Cathy Pattillo, Victoria Perry, Jesmin Rahmin, and Genevieve Verdier, for useful suggestions, Carla Intal for excellent research assistance, and Jing Wang and Biva Joshi for excellent administrative support. This paper is part of a research project on macroeconomic policy in low-income countries supported by the U.K.'s Department for International Development (DFID), and it should not be reported as representing the views of the International Monetary Fund or of DFID.

Contents Page

Tables

Figures

I. Introduction

In the past several decades, the world moved closer to gender equality and saw the advancement of women across a wide range of economic, social, and political indicators, in all regions of the globe. Nonetheless, throughout the world, women remain at a disadvantage to men in important areas of social, economic, and political life. The Millennium Development Goals explicitly called for gender equality. Its successor, the Sustainable Development Goals, adopted in 2015, sets targets for the international community over the next 15 years.[1] Goal 5 of its 17 broad goals explicitly calls for gender equality and the empowerment of women and girls.

This paper examines trends in indicators of gender equality and advancement of women, using evidence derived both from individual indicators and gender equality indices, which aggregate a number of critical indicators. We introduce our own version of the gender indices constructed by the United Nations Development Program (UNDP), namely, the Gender Development Index (GDI) and Gender Inequality Index (GII). We replicate and reconstruct these indices backward in time in a consistent manner to examine trends over several decades.

In the first part of the paper, we focus on individual indicators that are central in measuring aspects of women's life where equality is important, and also those of greatest relevance to developing countries, where gender-based differences or gaps tend to remain largest. Women's advancement in access to education and health status and an ability to earn income or participate in the labor market are all commonly accepted indicators of economic and social well being. In the political realm, women's participation in elected office and other key political positions is one way of measuring women's empowerment.

We find, as with a number of other recent studies, that the trends in individual indicators point toward improvement in education, health, economic opportunity, and political empowerment, but progress across the world is uneven.[2] When grouped by geographic regions, we observe that South Asia, the Middle East and Central Asia, and sub-Saharan Africa lag other regions, even though these regions have all recorded significant improvement in key indicators. When grouped by level of economic development, we see that countries at all levels of development have generally made progress, though there are periods when progress is more rapid than others. The low-income developing countries (LIDCs) tend to lag. The gaps between the advanced countries and emerging countries are surprisingly small on some indicators, suggesting that considerable progress can be made even while significant income gaps remain.

[1] See United Nations (2015).

[2] See Morrison et al. (2008), World Bank (2011), Clinton Foundation and Gates Foundation (2015), and UN Women (2015).

Because indicators capture distinct elements of women's equality with men, we also examine gender equality indices. We survey the growing literature on indices to highlight variations in their construction, which explains why countries may have different measures of equality, depending on the index. We focus our analysis of trends on our own newly created versions of the UNDP's GDI and GII, for which we have constructed a consistent series going backward in time. We use the UNDP's gender equality indices to construct the time series because these indices tend to be the most prominently used ones in this area, and because the individual variables used in their construction are similar to the key individual indicators presented in the first part of the paper. This parallel structure allows us to explain more easily the trends in the indices on the basis of the trends in the underlying indicators. As with the individual indicators, the trends in the gender equality indices show progress across the world in gender equality over the past few decades, although significant gaps remain when comparing countries grouped by region and by level of economic development. Some clear differences in the rates of change across regions and levels of development emerge.

The remainder of this paper is as follows: Section II contrasts individual indicators and gender equality indices and discusses some data-related issues. Section III examines trends in the individual indicators. Section IV contrasts different gender equality indices. Section V examines trends over time in the UNDP's two gender equality indices using our own versions of them. Section VI relates the gender equality indices to income. Section VII examines the use of indicators and indices for policy analysis. Section VIII concludes.

II. Indicators versus Indices and Data Issues

Two ways to capture trends in women's development and gender equality are through individual indicators and composite indices. Both approaches have distinct advantages and disadvantages.

Sex-disaggregated individual indicators provide information regarding one aspect of women's development or gender equality. They provide a readily accessible basis for assessing progress and offer insight for policymakers into specific development targets. On the other hand, because these indicators examine only one facet of women's development or gender equality, policymakers and researchers may overlook other key areas of focus. The various indicators may not always move together and may even move in inconsistent directions. Thus, it is helpful to analyze several different indicators to capture the trends.

Composite indices, derived from aggregating individual indicators, provide an alternative to individual indicators. The UNDP was a pioneer in constructing an index to measure women's development. Starting from the UNDP's Human Development Index (HDI), a widely respected series which aggregates measures of education, health, and income to assess relative human development levels among countries, the GDI was constructed to assess the

gap between men and women's development. The first version of the GDI could not be used independently of the HDI. In recent years, the UNDP has both revised the GDI to be a stand-alone index and created the GII. A number of other gender equality indices, designed to capture trends in equality and address gaps in previous indices, have appeared. Some of these indices are discussed in greater detail in section IV.

The main advantage of gender equality indices is their ability to provide a broader perspective than individual indicators. However, the different combination of indicators, weighting of indicators, and method of aggregation have led to a certain degree of arbitrariness in the formulation of the indices. This has led to an ongoing debate regarding the merits of each index, which we summarize later.[3]

Analyzing trends in gender equality is challenging because it requires some value judgments as to what is meant by equality between men and women.[4] We present trends, rather than levels, to avoid making judgments as to what the precise differences between females and males should be. We also use relative measures, mainly female to male ratios, which is the most common approach in the literature, rather than absolute differences.

For some variables, such as primary or secondary education completion rates, equivalence between men and women is a reasonable goal. Likewise, we would expect for political empowerment that equality between men and women is a reasonable goal, with some modest deviations expected in countries where, for various reasons related to conflict or migration, there may be a significant imbalance between women and men. In the area of health, women's natural life expectancy is about four to five years longer than men's. It is reasonable that gender equality would aim to achieve this biological norm rather than seeking to achieve exact equality of life expectancy.

Women's labor force participation rate is lower than men's in most countries. There is, nonetheless, considerable variation in the relative rates of participation and in some countries, women's participation rate has come close to men's participation rate, as the men's rate has plateaued or fallen. A large literature looks at determinants of women's labor force participation (e.g., Bertrand, 2011; Fernandez and Fogli, 2009). Differences in participation rates that cannot be explained by individual workers' rational choices or are influenced by social customs that preclude women from working when they would prefer to do so would suggest unaddressed gender biases.

[3] See also Klasen (2006b), Klasen and Schüler (2011), Hawken and Munck (2013), Permanyer (2013), and Van Staveren (2013).

[4] See Klasen (2004) and Casarico and Profeta (2015) for further discussion.

Good indicators should satisfy a number of properties, including broad country coverage and availability on a long time series basis. These indicators should be constructed in similar ways across countries and over time. Sex-disaggregated data suffer from spotty coverage across time and countries, a constraint on the analysis, but one that does not fundamentally undermine the ability to track trends in key variables. Appendix A provides more detail on gender-relevant indicators available in the World Bank's World Development Indicators database and the degree of their country coverage over time.

There are a number of international initiatives underway to improve these indicators. The United Nations (UN), in conjunction with a number of other international organizations, has launched a three-year international effort to identify and improve collection of key indicators on women's well-being, called the Evidence and Data for Gender Equality (EDGE) project. A primary goal is to supply data for the UN's Statistical Commission's Minimum Set of Gender Indicators, which covers areas related to women's participation in economic and political activities, access to resources, education, health, and human rights.[5] A supporting international gender data initiative is Data2X.[6]

Most microeconomic data on individual behavior are derived from household surveys. Only some of these data, such as labor force participation, are disaggregated by sex. Many variables, such as consumption or asset holdings, and often income, may only be available on a household basis. Klasen (2004) points to the lack of data on intra-household resource allocation, which limits analysis on how well men and women's different household needs are met. Folbre (2006) notes the importance of including time use data as another source of information, though these data can be difficult to obtain on a regular basis. Women have traditionally borne a disproportionate burden of unpaid work and, thus, improved information on time use provides a better understanding of men and women's well being, supplementing economic and other socioeconomic measures.

A related point is that data can be relevant to the analysis of gender even when they are not disaggregated by sex. In addition to household income, consumption, and assets, some key indicators of standard of living or quality of life in developing countries, such as access to power, clean water, and sanitation, and cooking fuels, are available only at the level of the household or community.[7]

---

[5] See UN Economic and Social Council (2014).

[6] See Buvinic et al. (2014).

[7] Agenor and Canuto (2015) incorporate into a model of growth how a lack of infrastructure affects women's allocation of time to formal labor markets.

III. Trends in Selected Indicators

We highlight trends using indicators from the areas of education, health, and economic and political opportunities. Table 1 defines these indicators in more detail.

For education, we use the gross secondary enrollment rate, which is a rough measure of the ability of boys and girls to acquire an education. Educational attainment is a key measure of human capability and the ability to lead a rewarding life, engage in civic activities, and improve the living standards of one's children. Although the net secondary enrollment rate is viewed as more accurately depicting the enrollment at a particular level or grade of education because it excludes over- and under-age enrollment (Grown, 2008) and the completion rate could more accurately measure achievement, we use the gross enrollment rate because of the high correlation of the three indicators and greater availability of data.[8]

Table 1. Definitions of Selected Gender Indicators

Indicator	Definition
Gross secondary enrollment rate	Gross enrollment rate is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and lays the foundations for lifelong learning and human development by offering more subject- or skill-oriented instruction using more specialized teachers.
Life expectancy at birth	Life expectancy at birth indicates the number of years a newborn infant is expected to live if prevailing patterns of mortality at the time of his/her birth were to stay the same throughout his/her life.
Child mortality, under the age of 5	Under-five mortality is the probability per 1,000 live births that a newborn child will die before age 5, if subject to age-specific mortality rates of the specified year.
Maternal mortality ratio	Maternal mortality ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births. The data are estimated with a regression model using information on the proportion of maternal deaths among non-AIDS deaths in women aged 15-49, fertility, birth attendants, and GDP.
Labor force participation rate, ages 15-64	Labor force participation rate for aged 15-64 is the proportion of the population aged 15-64 that is economically active: all people who supply labor for the production of goods and services during a specified period.
Mean nominal monthly earnings of employees	The concept of earnings, as applied in wage statistics, relates to gross remuneration in cash and in kind paid to employees, as a rule at regular intervals, for time worked or work done together with remuneration for time not worked, such as annual vacation, other type of paid leave or holidays. This indicator is presented in terms of the average monthly earnings per employee, in local currency, and disaggregated by sex.
Seats held by women in national parliaments	Seats held by women in parliaments is the percentage of parliamentary seats in a single or lower chamber held by women.

Sources: World Bank, World Development Indicators database; and International Labor Organization (ILO), ILOSTAT.

[8] In our sample, the gross enrollment rate has a correlation of about 0.9 with net enrollment and completion rates in the overall and developing country samples. Nonetheless, there is need for more comprehensive data.

For health, we select life expectancy at birth, because it is one of the most widely used summary indicators of health status and captures many variables that affect health and well-being. One advantage of using this variable is that it is available in a wide cross-section of countries on an annual basis making it useful for comparative analysis. One drawback to the use of the life expectancy at birth measure is that it reflects the life expectancy of those alive and neglects the selective reduction of the female population through sex-selective abortion and differential treatment of male and female children in the home (Klasen, 2006b). However, isolating the effect of these gender-related behaviors would be difficult in a broad panel dataset. Life expectancy at age 60 is an alternative measure, which would be another meaningful indicator of health, because it reduces the disproportionate influence that early childhood mortality has on life expectancy at birth. While it has reasonably good country coverage, it is available with less frequency, so we opted for the life expectancy at birth measure.

Because our focus is developing countries, we also use two additional indicators, under-5 child mortality and maternal mortality. Child mortality is useful because it is available on a sex-disaggregated basis and thus can capture the effect of differential treatment of girls and boys in the home. Maternal mortality is a critical indicator of women's advancement and well being, and it is incorporated in some gender equality indices, even though no comparison of women and men is possible. Maternal mortality has one significant drawback in that few developing countries collect the information necessary to measure it accurately, and thus it is an estimated variable and likely to be measured with some error.[9]

To capture trends in economic opportunity, we select labor force participation rate because it is an informative indicator of women's economic role and has been a focus of policymakers. In addition, it has the best data quality and availability compared to other economic indicators available on a sex-disaggregated basis. Nonetheless, this variable has limitations in that it does not take fully into account the complexity of the job market, especially in countries where the informal labor market and subsistence agriculture comprise a significant part of the labor force. Unfortunately, alternative measures of labor force participation that would subdivide this variable into finer components are not widely available for the scope of countries considered in this survey.[10]

Several measures of earnings of men and women are available but lack the comprehensiveness of the labor participation data and are constructed or estimated variables, thus introducing a greater degree of measurement error. Notwithstanding the more limited

[9] An important goal should be to improve civil registration and vital statistics in countries with poor maternal mortality data to ensure the availability of more accurate data on this key variable.

[10] Another useful variable would be unemployment, but again the data are lacking for this cross-country sample.

data, we present trends in wages by sex using mean monthly earnings of employees. One unavoidable limitation of this variable is that it mixes two separate factors: hours of work and pay per hour.

Although we concentrate mainly on trends in economic and socioeconomic variables, we also include an analysis of political opportunity because, as a measure of empowerment, it helps to characterize the status of women in society and is complementary to the economic measures. For political opportunity, the only indicator with reasonably comprehensive data coverage is the proportion of seats held by women in national parliaments. However, we note that this indicator alone does not necessarily give a full picture of women's political empowerment for a few reasons. Women's parliamentary presence does not always translate into an accurate measure of women's political empowerment, especially in countries where parliament plays a circumscribed role. In addition, this measure only looks at women's participation in the lower house of parliament. Women are also underrepresented at the ministerial and other levels of government around the world.

A. World Trends by Region and Income Group

This section presents world trends for selected indicators, broken down both by region and by income level, between 1980 and 2014. As one focus of this paper is LIDCs, the trends for these countries are investigated as well. We use data from all countries for which there were data. To group countries by region, we use the International Monetary Fund (IMF) classification: sub-Saharan Africa, the Americas and Caribbean, Asia and the Pacific, Europe, and the Middle East and Central Asia. Newly-formed countries, such as Timor-Leste, South Sudan, and the former Soviet republics, enter the sample in the year they came into being.[11]

The LIDCs group is a relatively new IMF category and consists of 60 countries. Countries included in the LIDC grouping were designated as eligible for an IMF-supported lending program, called the Poverty Reduction and Growth Trust (PRGT) and had a level of per capita gross national income less than an unadjusted US$2,390 in 2013 (IMF, 2014). India, Pakistan, and the Philippines have been excluded from the LIDC country grouping despite having a per capita income that falls below US$2,390 (IMF, 2014). These countries are not PRGT-eligible because they have access to international financial markets and are viewed as resembling emerging markets. Europe has only one LIDC, Moldova, so we exclude this region from the LIDC analyses.

Countries are classified by level of economic development following the IMF designation in 2014. Some countries may have switched income classification over time but were held in

[11] Appendix B provides details.

the same category over the entire period of the sample.[12] To smooth trends and account for data gaps over time and/or countries, we construct non-overlapping five-year averages.[13] In addition, we weight each averaged country observation by the five-year average population share in the region to capture its relative importance. And as noted, we examine female to male ratios for all indicators except for maternal mortality and proportion of seats held by women in national parliaments.

B. Education

Figure 1 presents trends of the female to male ratio of gross secondary enrollment from 1980-2014 for countries aggregated by region and level of development and for LIDCs by region. All regions saw an increase in the female to male ratio over this period, suggesting progress in equalizing female and male access to secondary education, a trend also illustrated in World Bank (2011).

However, gender gaps in secondary enrollment still persist, particularly in sub-Saharan Africa and the Middle East and Central Asia. Notably, the ratio in the Americas and Caribbean is above one for most of this period, while Europe is close to one, though dropping a bit toward the end of the sample. The Asia and Pacific region's ratio approaches one by the end of the sample and in fact exceeds Europe's ratio at sample end, reflecting a dramatic improvement in the Asia and Pacific region over the sample period.

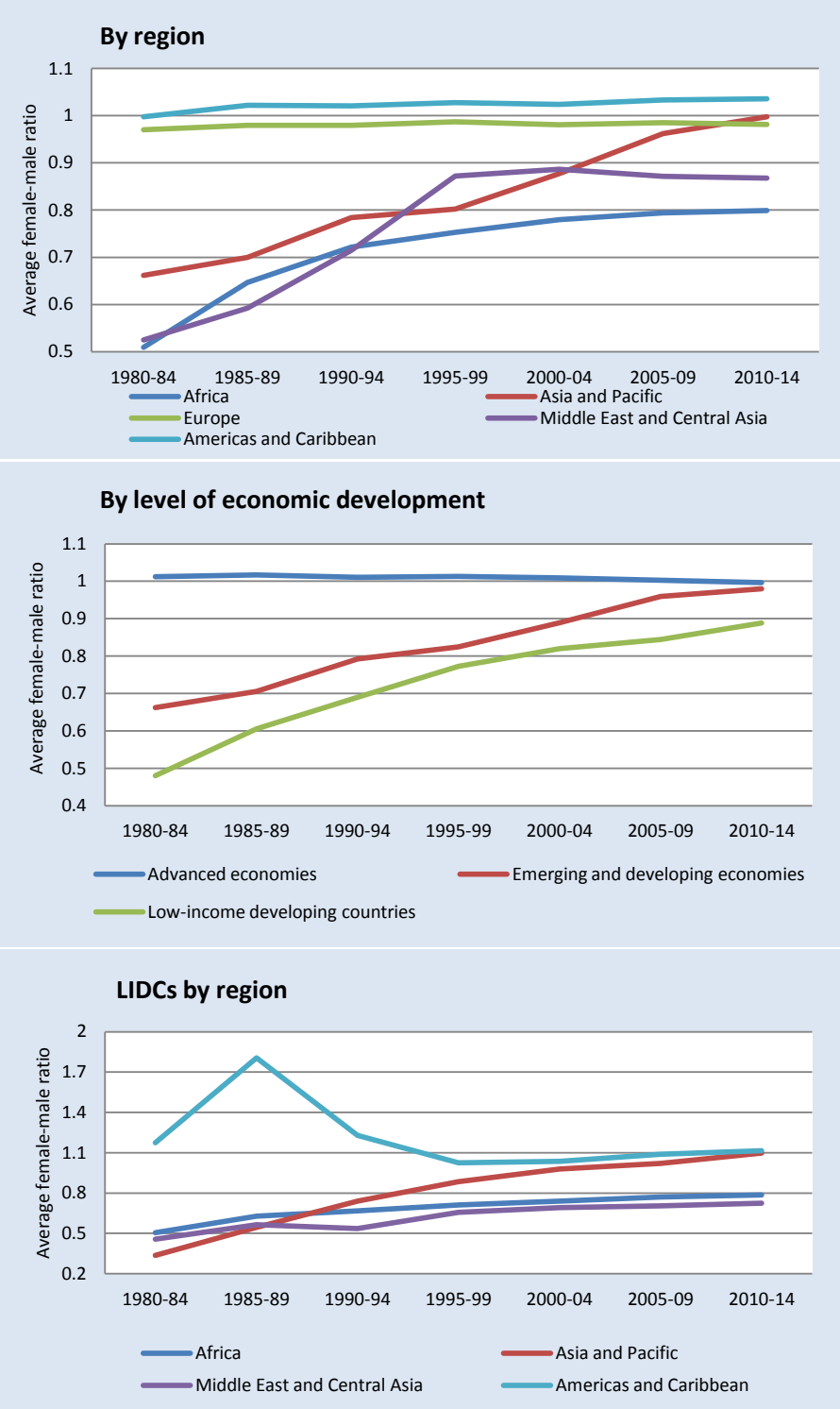
The trends by income level show that all groups saw convergence in the ratio toward one. While LIDCs continue to lag, they made substantial progress in narrowing the gap over the sample period. The regional trends among LIDCs also present a similar picture. There is a general upward movement in sub-Saharan Africa, Asia and the Pacific, and the Middle East and Central Asia.[14] Despite this progress, LIDCs in sub-Saharan Africa and the Middle East and Central Asia still lag LIDCs elsewhere, and there remains considerable scope to narrow the educational gap further.

[12] Few countries change their broad income classification over time. From sample beginning to end, only 10 countries move from the developing and emerging category to the advanced, and all of these with the exception of Korea are small countries, and altogether they have a minimal effect on the population-weighted averages.

[13] If data are available for only a portion of the five years, we generate the average from the years for which the data were available. Because the indicators change slowly over time, this methodology does not introduce any significant bias; to check, we calculated the average using only countries that had at least half the annual observations for each variable (for child and maternal mortality, all countries would be dropped due to lack of data availability) and found no significant difference in the results.

[14] The bump in the Americas and Caribbean reflects a variation resulting from one country and a small sample size and is thus not meaningful.

Figure 1. Gross Secondary Enrollment
(Female to male ratio)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

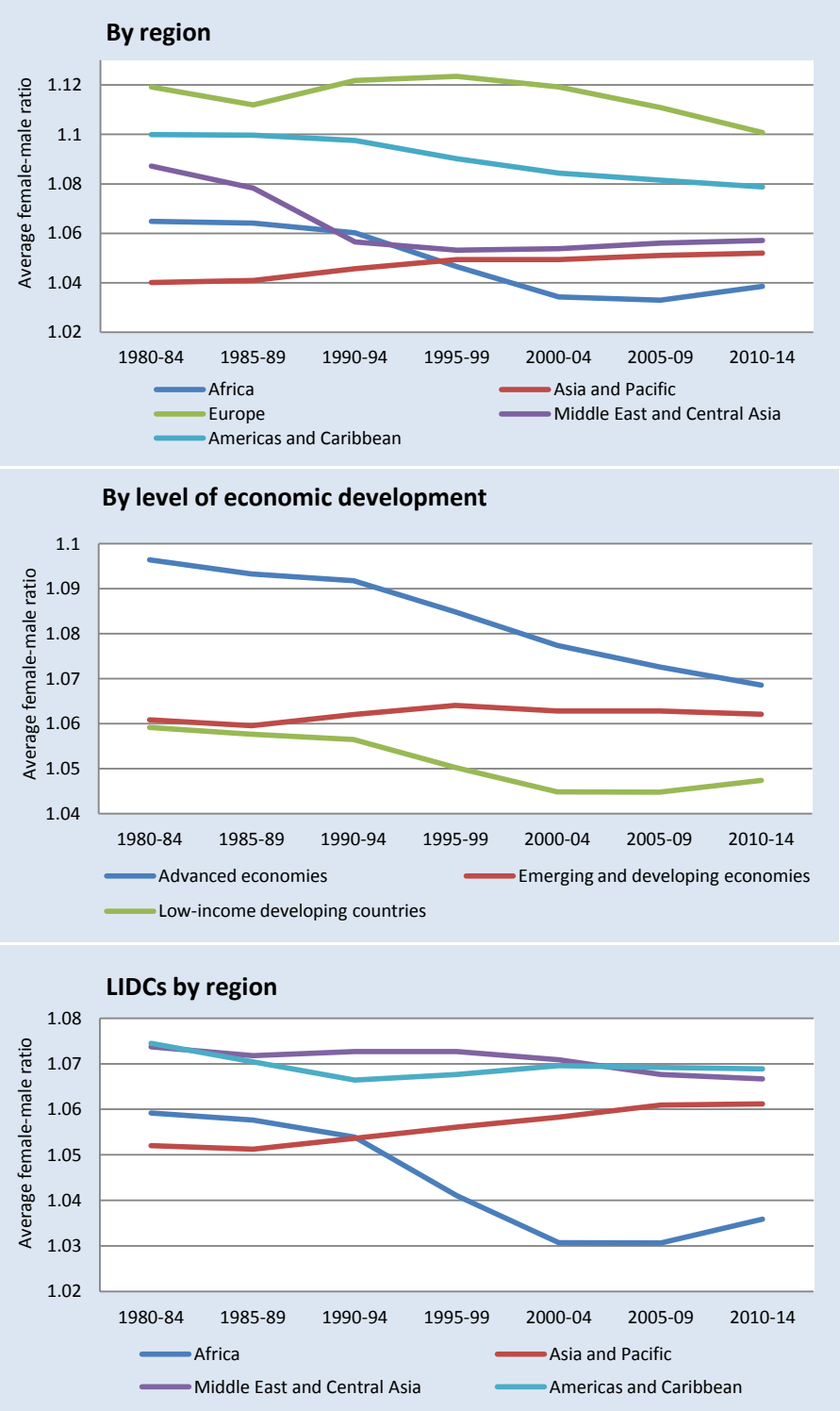
C. Health

Figure 2 presents regional trends in the female to male ratio of life expectancy at birth from 1980-2014. All of the regions show a ratio above one, reflecting that the natural life expectancy for females exceeds males. The female to male ratio is markedly decreasing in advanced countries. Evidence found elsewhere for advanced countries also shows this recent pattern of a closing gap between female and male life expectancy (Liu, Arai, Kanda, Lee, Glasser, and Tamashiro, 2012; Thorslund, Wastesson,Agahi, Lagergren, and Parker , 2013). This reversal of the pattern from earlier in the 20th century of female life expectancy rising faster than male's may reflect any number of factors, including the influence on health of habits, such as smoking, that women picked up at increased rates mid-century or the success in reducing cardiovascular disease. In the Americas and Caribbean, where developing countries dominate the trend, we observe the same declining ratio. In the remaining regions and developing countries, in general, we see a flat or rising ratio in recent years (after marked declines in Africa and the Middle East earlier in the sample period), so that females are approaching the natural biological advantage over males. Only the Asia and Pacific region shows a consistent increase in the gender ratio over time, reflecting women's very disadvantaged position, which is only slowly resolving over time. The most notable LIDC trends are the steady rise in Asia and fall and recovery in Africa, similar to the top panel.

Figure 3 presents the trends in female and male life expectancy, separately, measured by average life expectancy in years. Gender gaps narrowed not because female life expectancy worsened but because male life expectancy rose faster than female life expectancy. Notably, in sub-Saharan Africa, women's life expectancy was basically flat over a substantial period of the sample, only rising toward the end, while men's life expectancy gradually rose over the entire period and almost closed the gap in life expectancy. This unusual pattern of flat life expectancy may reflect the disproportionate impact of HIV/AIDS on African women.

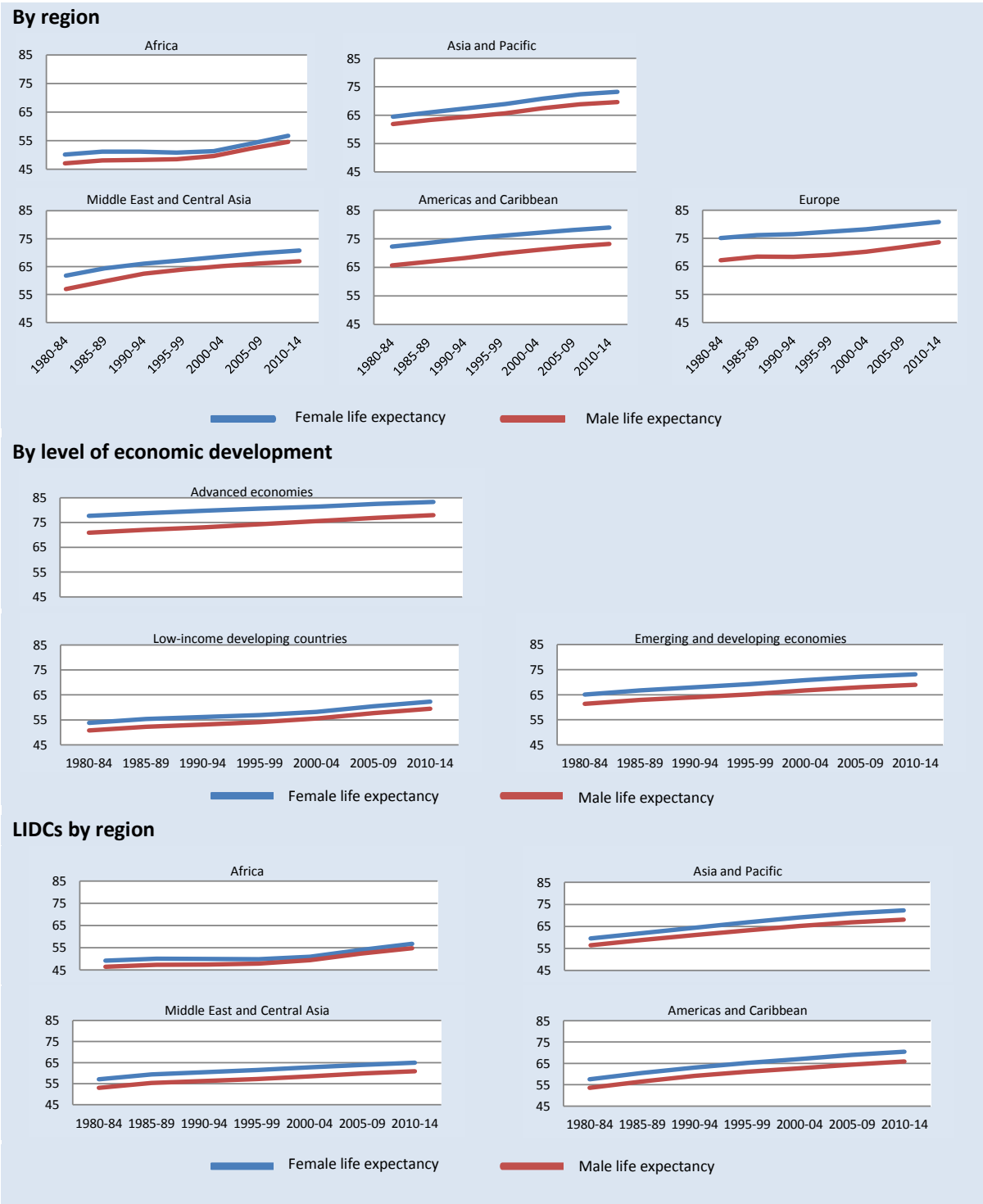
Figure 4 presents the number of countries with a life expectancy ratio of females to males falling below 1.05, taken to be around the biological norm, from 1980-2014. Over this period, an increasing number of countries saw their ratio fall below 1.05, with most of this increase in Africa, consistent with the trends in Figure 2.

Figure 2. Life Expectancy at Birth
(Female to male ratio)



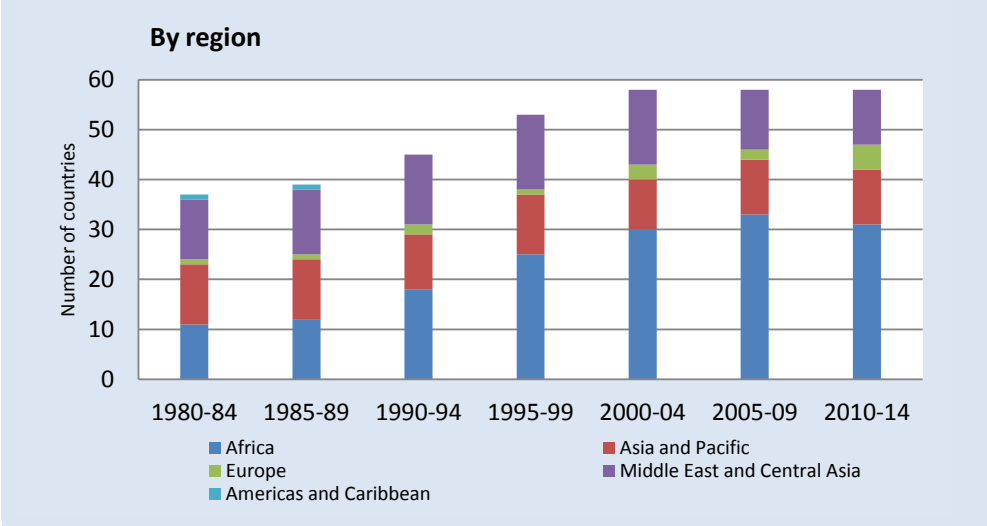
Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 3. Life Expectancy at Birth
(Years)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 4. Number of Countries with Female to Male Life Expectancy Ratio Below 1.05



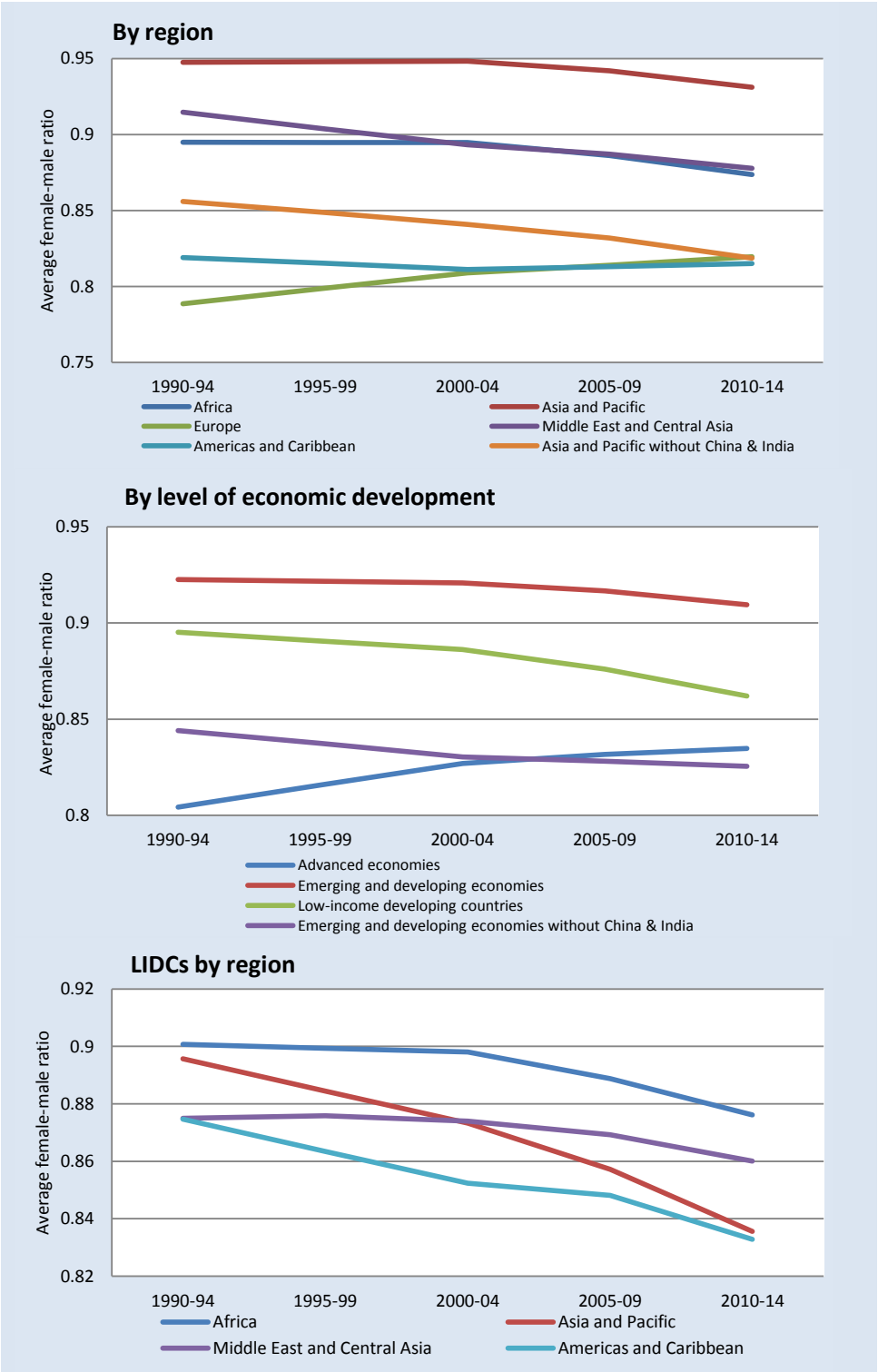
Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 5 presents trends in the female to male ratio of child mortality from 1990-2014. All of the regions show a ratio below 1, reflecting a biological regularity in favor of girls. In fact, India is the only country in our data set where child mortality of females exceeds that of males. China is also an outlier in having a high relative mortality of girls. All regions of the world show a decline in mortality of female and male children over time, so that the changing gender gap reflects differences in the rate of decline. When broken down by region, level of development, or LIDCs, the trends point to a decreasing ratio of female to male mortality, with the exception of Europe and advanced countries (resulting from Europe's trends), which could reflect the changing country sample or country demographics.[15] By region, Africa and the Middle East and Central Asia have higher relative female mortality than other regions except Asia, whose ratio is raised by the inclusion of China and India.

Figure 6 presents trends in maternal mortality ratios from 1980 to 2014. All regions of the world achieved a decline in maternal mortality. While sub-Saharan Africa has the highest rate of mortality, it also declined significantly over this period, almost halving. Asia and the Pacific and the Middle East and Central Asia also achieved a significant decline in the maternal mortality ratio, while the decline in the Americas and Caribbean was gradual and the ratio remains slightly higher than Europe. Emerging markets and LIDCs achieved a large reduction, and the progress was spread across the LIDCs.

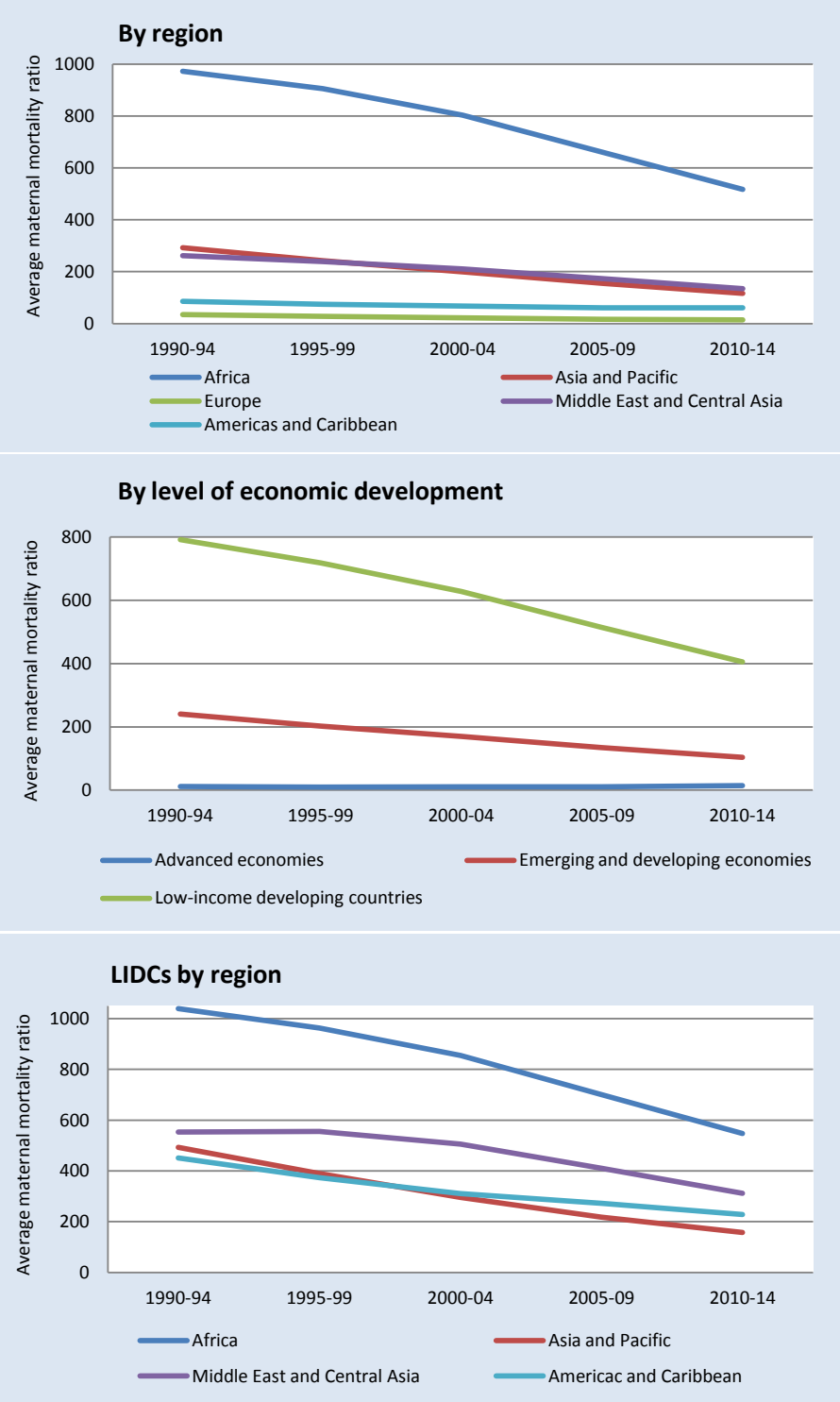
[15] The data are available for 4 years, stretched out over an approximate 10-year interval, for each country. We have smoothed the series to construct 5-year intervals.

Figure 5. Child Mortality, Under the Age of 5
(Female to male ratio)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 6. Maternal Mortality Ratio
(Modeled estimate, per 100,000 live births)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

D. Economic opportunity

Figure 7 presents regional trends in economic opportunity, measured by the female to male ratio of labor force participation, among people aged 15 to 64. In general, countries throughout the world are heading toward greater gender parity in labor force participation. One striking observation is the gap between the Middle East and Central Asian region and other regions in the world in the labor force participation ratio.[16]

The Asia and the Pacific region has exhibited a declining trend in the participation ratio in recent years, even as the education gap has closed, a trend driven by declining female labor force participation in India and, to a lesser extent, China. A number of studies have examined India's trends (ILO, 2013; Das, Jain-Chandra, Kochhar, and Kumar , 2015; Klasen and Pieters, 2015) and attributed the tendency for declining labor force participation of women to a combination of supply and demand factors, which include rising enrollment in secondary and tertiary education among women and increasing household income, which affords some women the opportunity to withdraw from the labor market; fewer job opportunities in industries where women predominate; and gender barriers in the work place. Without India, the participation ratio is much higher in the Asia and Pacific region. Without China and India in the calculation, the participation ratio has risen slightly over the sample period.

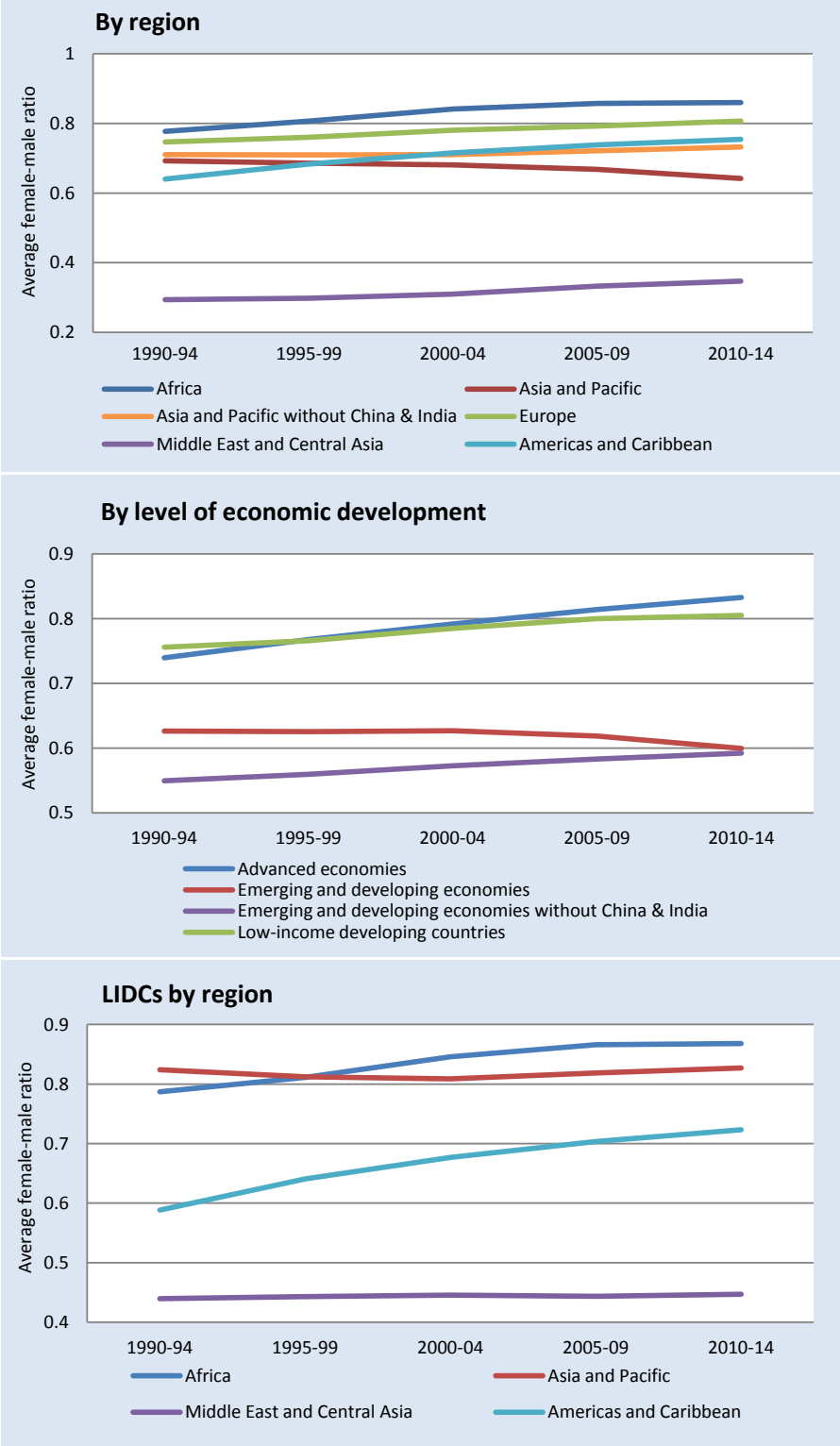
The trends by the level of income show that the advanced economies and LIDCs moved significantly toward parity in the past two decades. The striking increase in female participation in the Americas and Caribbean is notable. Meanwhile, the emerging and developing economies have lagged, reflecting in part the weight of China and India in the calculation. In LIDCs, we can see that the Middle East and Central Asia lags, although the trend in Asia and the Pacific is relatively flat. Sub-Saharan Africa has the highest ratio, even while Africa women remain concentrated in the informal sector and subsistence agriculture.

Figure 8 presents the trends separately for males and females, and we see that except in the Asia and Pacific region, labor supply of women has been rising, whereas men's has been relatively flat and is even declining in some regions.

As an alternative, we explored wage differences between men and women. Although advanced nations have good coverage and workers earning wages would encompass the larger part of the labor market, the coverage of emerging and developing countries is more modest and LIDCs coverage is limited to a few countries. Using only the countries for which data were available over the 1995-2011 period, Figure 9 shows that wage gaps between women and men diminished slowly in this period, in advanced and emerging markets, consistent with UN Women (2015) findings, which explores this trend in more detail.

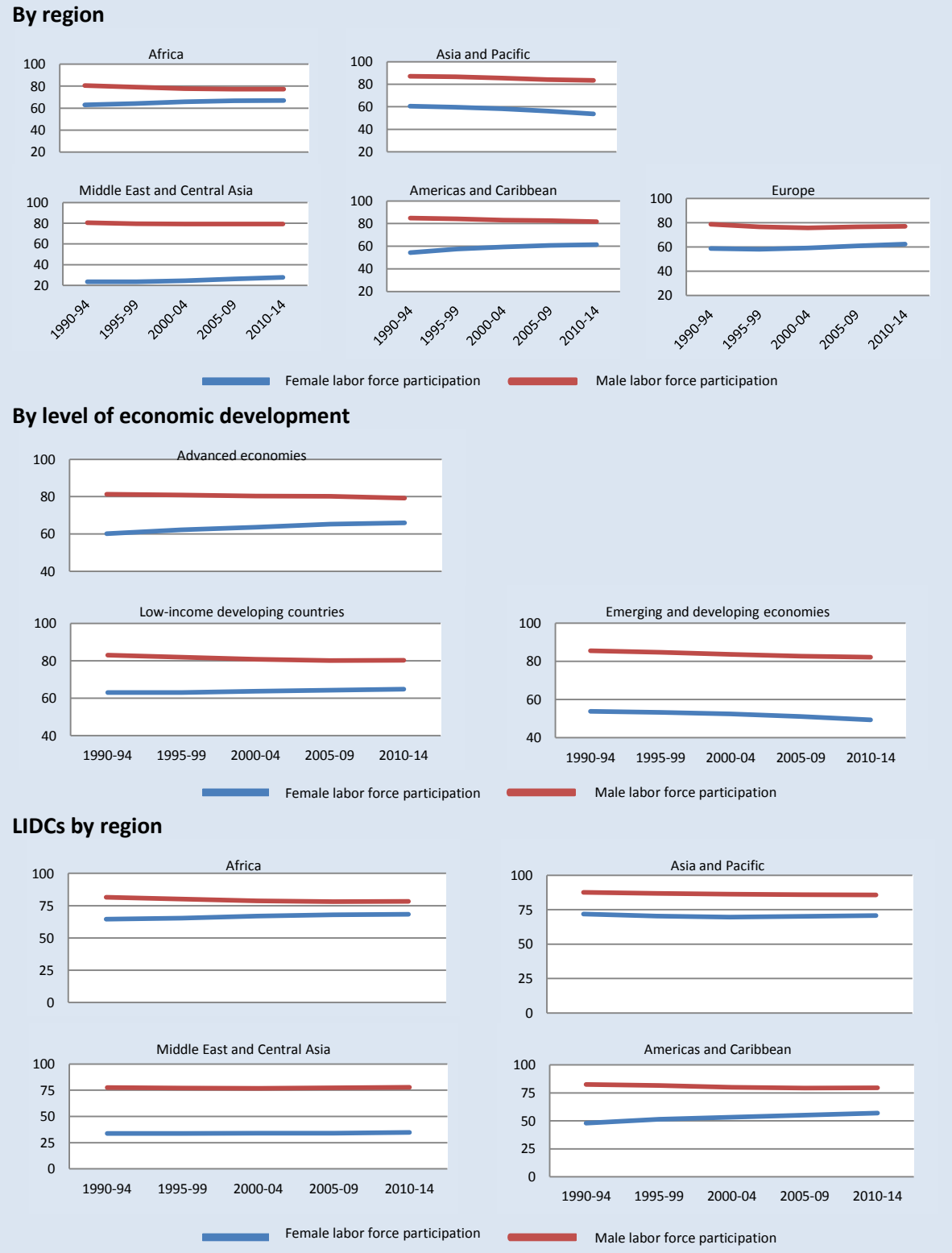
[16] See Mithra and Farid (2013) for discussion of this issue.

Figure 7. Labor Force Participation Rate, Ages 15-64
(Female to male ratio)



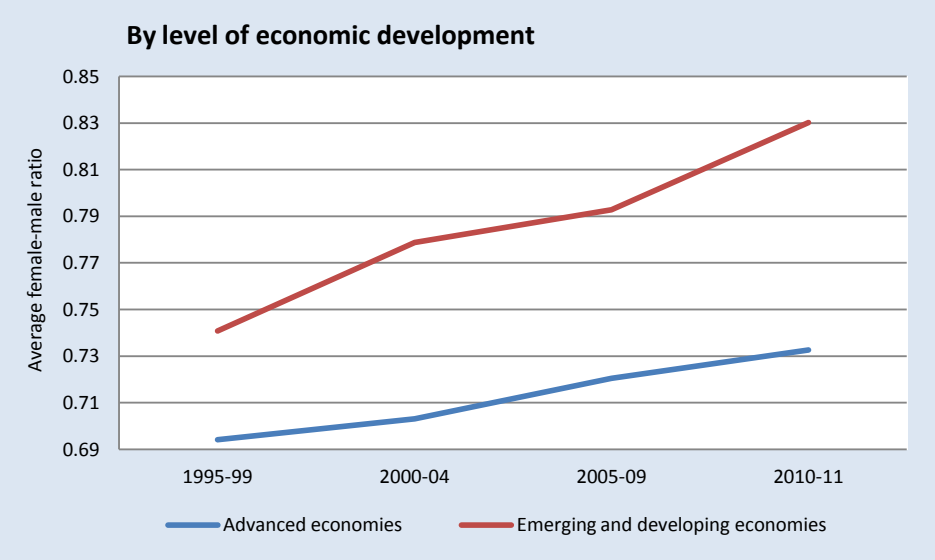
Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 8. Labor Force Participation Rate, Ages 15-64
(Percent)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

Figure 9. Mean Monthly Earnings of Employees
(Female to male ratio)



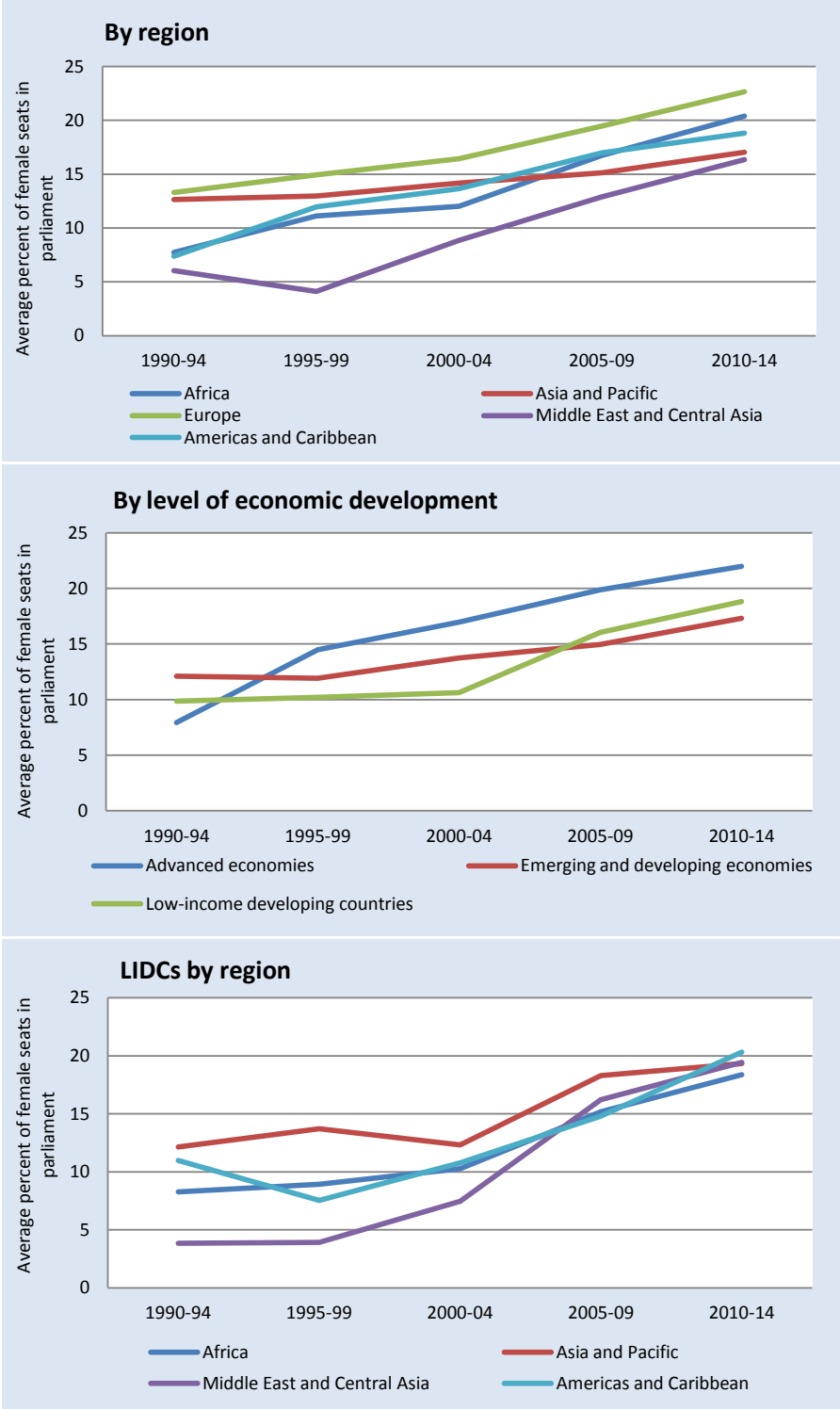
Sources: ILO, ILOSTAT; and IMF staff estimates, using 38 countries, whose data encompassed the relevant period of analysis.

E. Political opportunity

For a final individual indicator, we look at political opportunity. Figure 10 presents the trends for the proportion of seats held by women in national parliaments. Overall, the data show all regions of the world made substantial progress in improving women's legislative representation. Nonetheless, women's representation remains well below 50 percent in every region. Two countries, Rwanda and Bolivia, have achieved the milestone of over half of the legislative body being women in 2015. Strikingly, despite the relative lack of economic progress for women in the Middle East and Central Asia, women did make gains commensurate with other regions in increasing political representation. Also notable is the rapid improvement in sub-Saharan African women's political representation. Although starting significantly lower than Asia and the Pacific, by sample end, sub-Saharan Africa had a higher overall representation of women.

The trends by level of income show the same underlying developments. Countries at all levels of income made progress in increasing women's political representation, with LIDCs making more rapid progress. The trends for the LIDCs, aggregated by region, are similar to those overall. Among sub-Saharan African LIDCs, Rwanda and Senegal show a significant increase in the share of female parliamentarians in the late 2000s, which may reflect the effect of quotas (Bauer, 2013). In the Asia and Pacific region, Nepal shows a sizeable increase. In the Middle East and Central Asia, all LIDCs except for Yemen contribute to the regional improvement. A similar phenomenon is shown in the Americas and Caribbean where all LIDCs except for Haiti contribute to the increase in women's representation.

Figure 10. Seats Held by Women in National Parliaments
(Percent of total)



Sources: World Bank, World Development Indicators database; and IMF staff estimates.

IV. Overview and Comparison of Gender Equality Indices

This section examines several of the more prominent gender equality indices. These are the UNDP's GDI and GII, the Global Gender Gap Index (GGGI) of the World Economic Forum (WEF), the Social Institutions and Gender Index (SIGI) of the Organization for Economic Cooperation and Development (OECD), the Women's Economic Opportunity Index (WEOI) of the Economist Intelligence Unit (EIU), the Gender Equity Index (GEI), the Relative Status of Women (RSW) index, and the Gender Gap Measure (GGM) index.[17,18]

The current section is organized as follows. First, we examine the construction of the "old" GDI, perspectives related to quantifying gender equality through index construction, and criticisms that led to the development of alternatives to the GDI, including the "revised" GDI. We then examine each of the other indices, present key features, and compare the indices.

A. Gender Development Index, Old and Revised

In 1995, the UNDP introduced two indices: the old GDI and the Gender Empowerment Measure (GEM). The old GDI was the first widely used index to analyze women's development issues and established the usefulness of a gender index. The index, though, was subject to several criticisms. For instance, Klasen (2006a) and Schüler (2006) note that it was not a measure of gender equality but instead a measure of how the HDI score was lowered by gender inequalities. In response to these criticisms, the UNDP suspended the old GDI in 2010 and introduced, in 2014, a revised GDI (UNDP, 2014a). There are thus two different indices using the same name and acronym, whose different methodologies are covered in this section. Aside from a change in computation of the index, the UNDP did not change the components of the GDI, which still comprise the education, health, and income variables of the HDI (UNDP, 2014b).

Box 1 lays out the methodology of the calculation of the old and revised GDIs and summarizes the evolution of the indices over time. The 'old' GDI, like the HDI, employed three sub-indices with variables reflecting educational attainment, health status, and income. The indicators for health and education were scaled on the ratio of the difference between actual and assumed minimum value of the indicator and the difference between the assumed maximum and minimum values of the indicator. The indicator for income was constructed differently.[19] A gender-equity-sensitive indicator was calculated for each indicator, using

[17] Appendix 3 provides details on data availability and country scope.

[18] The Women's Empowerment in Agriculture Index (IFPRI, 2012), the African Gender Equality Index (AFDB, 2015), and the Gender Equality Index 2015 (European Institute for Gender Equality, 2015) are three other indices with focus on a particular sector or region, respectively.

[19] See UNDP (1995) for details.

Box 1. Comparison of the HDI, GDI, and GII

	Sub-indices	Indicators used for each sub-index	Sub-index formula	Aggregation
1995 HDI	1. Life expectancy index.	1. Life expectancy at birth (min. 25 years and max. 85 years).	For the life expectancy and educational attainment indices: $Sub-index = \frac{actual\ indicator\ value\ -\ min.\ indicator\ value}{max.\ indicator\ value\ -\ min.\ indicator\ value}$ The education attainment index aggregates the adult literacy and combined secondary and tertiary enrollment indices as follows: $Educational\ attainment\ index = \frac{\left[2(adult\ literacy\ index)+(combined\ enrollment\ index)\right]}{3}$ The GDP per capita index involves a more complex process based on the Atkinson formulation for the utility of income.	Simple average of all sub-indices: $HDI = \frac{sum\ of\ the\ sub-indices}{3}$
	2. Educational attainment index.	2a. Adult literacy (min. 0% and max. 100%) 2b. Combined primary, secondary and tertiary enrollment ratio (min. 0% and 100%).		
	3. Standard of living index: Real GDP per capita is adjusted for the diminishing marginal utility of higher levels of income to human development.	3. Real GDP per capita (PPP$) (min. PPP$100 and max. PPP$40,000).		
Original GDI	Same as the 1995 HDI.		Each sub-index is calculated for females and males; $Sub-index_{female/male} = \frac{actual\ indicator\ value_{female/male} - min.\ indicator\ value_{female/male}}{max.\ indicator\ value_{female/male} - min.\ indicator\ value_{female/male}}$ The GDP per capita index uses the same computation as the 1995 HDI. Then, a gender-equity-sensitive indicator (GESI) is calculated for each sub-index, using the formula below. $GESI = \left[PFP\left(female\ sub-index^{(1-\varepsilon)} \right) + PMP\left(male\ sub-index^{(1-\varepsilon)} \right) \right]^{\left(\frac{1}{(1-\varepsilon)}\right)}$ PFP stands for the proportion of female population, and PMP the proportion of male population. Ɛ is inequality aversion. UNDP assumes Ɛ=2. This process essentially imposes a penalty on the HDI. For the standard of living index, the international average real adjusted GDP per capita is multiplied by its GESI to derive a gender-inequality adjusted GDP per capita.	Same as the 1995 HDI.

Box 1. Comparison of the HDI, GDI, and GII continued

<table>
<tr><th></th><th>Sub-indices</th><th>Indicators used for each sub-index</th><th>Sub-index formula</th><th>Aggregation</th></tr>
<tr><td>1999 HDI</td><td colspan="4">Same as the 1995 HDI except 1) the GDP per capita uses logarithms; and 2) its minimum is PPP$200.</td></tr>
<tr><td>1999 GDI</td><td colspan="4">Same as the original GDI except for 1) the changes made to the 1999 HDI; and 2) the change in the computation of the adjusted income index.</td></tr>
<tr><td>2000 HDI</td><td colspan="4">Same as the 1999 HDI except 1) the adult literacy is taken from age 15 and above; and 2) the combined enrollment ratio is uncapped.</td></tr>
<tr><td>2000 GDI</td><td colspan="4">Based on the 2000 HDI.</td></tr>
<tr><td rowspan="4">2010 HDI</td><td>1. Life expectancy index (LE).</td><td>Same as the 2000 HDI.</td><td rowspan="2">The formula below is applied to all indicators with some variations such as applying logarithms for income.
$Dimension\ index = \frac{actual\ indicator\ value - min.\ indicator\ value}{max.\ indicator\ value - min.\ indicator\ value}$</td><td rowspan="3">Geometric mean of all sub-indices:
$HDI = \left(LE^{\frac{1}{3}} \cdot \mathrm{ED}^{\frac{1}{3}} \cdot GNI^{\frac{1}{3}} \right)$</td></tr>
<tr><td rowspan="2">2. Education index (ED).</td><td>2a. Mean years of schooling.</td></tr>
<tr><td>2b. Expected years of schooling.</td><td>For the education index, after the above formula is applied to each indicator, the dimension indices are geometrically averaged.</td></tr>
<tr><td>3. GNI index.</td><td>GNI per capita (PPP$).</td><td></td></tr>
<tr><td rowspan="3">2014 GDI</td><td>1. Life expectancy index (LE).</td><td>Same as the 2000 HDI.</td><td rowspan="3">The sub-index for each gender is calculated the same as the 2010 HDI</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">2. Education index (ED).</td><td>2a. Mean years of schooling.</td></tr>
<tr><td>2b. Expected years of schooling.</td></tr>
</table>

Box 1. Comparison of the HDI, GDI, and GII continued

	Sub-indices	Indicators used for each sub-index	Sub-index formula	Aggregation
	3. GNI index.	Wage, female and male shares of economically active population, female and male share of the population, GNI per capita (PPP$).	$Sf = \frac{\frac{Wf}{Wm} * EAf}{\frac{Wf}{Wm} * EAf + EAm}$ $\quad Sm = 1 - Sf$ Where Sf and Sm are the female and male shares of the wage bill respectively, and EAf and EAm are the female and male shares of economically active population respectively $GNIpc_f = GNIpc * Sf/Pf \quad GNIpc_m = GNIpc * Sm/Pm$ Where Pf and Pm are the female and male shares of the population respectively $Dimension\ index = \frac{ln\ (GNIpc_{sex}) - ln\ min\ indicator\ value}{ln\ max\ indicator\ value - ln\ min\ indicator\ value}$	GDI is the simple ratio of female HDI to male HDI: $GDI = \frac{HDI_{female}}{HDI_{male}}$ HDI for each gender is calculated the same as the 2010 HDI.
GII	1. Reproductive health index (RH).	1a. Maternal mortality ratio (MMR).	Each sub-index is calculated for each gender, and the three sub-indices are aggregated for each gender by the geometric mean as follows: $Geometric\ mean_{female} = \sqrt[3]{\left(\frac{1}{MMR} \square \frac{1}{AFR}\right)^{\frac{1}{2}} \square \left(PR_{female} \square SE_{female}\right)^{\frac{1}{2}} \square LFPR_{female}}$ $Geometric\ mean_{male} = \sqrt[3]{\left(PR_{male} \square SE_{male}\right)^{\frac{1}{2}} \square LFPR_{male}}$ The female and male means are then aggregated by the harmonic mean to create the equally distributed gender index (EDGI). $EDGI = \left[\frac{\left(geometric\ mean_{female}\right)^{-1} + \left(geometric\ mean_{male}\right)^{-1}}{2}\right]^{-1}$	GII is a simple comparison of the EDGI to the reference standards; $GII = 1 - \frac{EDGI}{geometric\ mean_{f,m}}$ where the denominator is calculated as follows. $Geometric\ mean_{f,m} = \sqrt[3]{\overline{RH} \square \overline{EM} \square \overline{LM}}$ Each index is aggregated by the arithmetic mean using equal weights treating the genders equally.
		1b. Adolescent fertility rate (AFR).		
	2. Empowerment index (EM).	2a. Population with at least secondary education (SE).		
		2b. Shares of parliamentary seats (PR).		
	3. Labor market index (LM).	3. Labor force participation rates (LFPR).		

female and male weights in the population and scaled with an inequality aversion coefficient, which the UNDP assumed to be 2. The GDI was then the simple average of the sub-indices.

Hawken and Munck (2013) commended the GDI for its clear overarching concept of human development, while noting that it made use of relatively few indicators, in part reflecting the availability of data at the time the index was introduced.[20]

A series of articles in a special issue of the *Journal of Human Development* (2006), edited by Stephan Klasen; Bardhan and Klasen (1999, 2000); and Klasen and Shüler (2011) highlight a number of conceptual and empirical problems with the old GDI, which are useful to discuss because they illuminate issues that continue to be a source of concern with some of the more recently developed indices. Klasen (2006a, 2006b) observes that the biggest gap in the old GDI index derives from the income variable, which is problematic in its measurement. Folbre (2006) suggests that some account should be taken of women's greater time devoted to unpaid or home activities, which are ignored by a measure based on income. Moreover, Chant (2006) notes that earned income may not be the most meaningful measure of equality because it does not necessarily translate into gaps in household spending given that pooling of income takes place in the home and because it cannot be assumed that women control their own earnings. Klasen (2006b) suggests replacing non-agricultural wages by economy-wide wages and seeking more complete data coverage of the earned income component. Dijkstra (2002) recommends replacing earned income with labor force participation.

Klasen (2006b) also notes that a weakness of the old GDI is that it is a measurement of gender equality rather than female disadvantage by compounding gender gaps, regardless of whether females or males are at a disadvantage. Thus it treats a country with negative gaps for females in all dimensions the same as a country with some gaps for females mixed with gaps for males. This reduces, for instance, the measure of female disadvantage in countries where women are advantaged in life expectancy but disadvantaged in education and earned income.

In contrast, the revised GDI (referred to hereafter as the GDI) is a direct measure of the gender gap, using the components of the HDI (which was also substantially revised in 2010), with sex-disaggregated data (UNDP, 2014b). The health variable remains life expectancy, with an adjustment for an average of female biological advantage over males of five years. The education variables are mean years of schooling and expected schooling. The previous estimation methodology for income is replaced by one based on gross national income (GNI) per capita in purchasing power parity dollars at 2011 constant prices and the ratio of female to male wages in all sectors, not just non-agricultural sectors. Where countries do not have

[20] Table 1 of their paper provides a useful summary of the methodological framework for the evaluation of indices.

wage data disaggregated by sex, the UNDP uses a presumed global average of female to male wages of 0.8.[21]

Geometric, rather than arithmetic, averaging is now used to aggregate the sub-indices. The basic comparison between females and males relies on the simple ratio of the HDI for females to males, following recommendations in Klasen (2006b) and Klasen and Schüler (2011). Thus, while the index typically ranges from 0 to 1, it may be above 1 when females are deemed to be more advantaged than males. Numbers closer to 1 imply more equal gender relations. Countries are ranked based on the absolute value of the deviation of the GDI from 1 (gender parity), which gives a different ranking than on the basis of the GDI value alone when some countries have a ratio exceeding 1. The GDI continues to be a measure of gender equality. However, rather than compounding gaps, it allows for compensation of female and male gaps through the use of the geometric mean. To convert it into a measure of female disadvantage, the ratios could be capped at gender equality. Klasen (2014) commends the revised GDI as a significant improvement over the old GDI, while noting that the use of earnings is still a weakness in this index.

UNDP (2014b) reports that the world average GDI value is 0.920, indicating a gap of 8 percent in the HDI for females from that for males, based on a calculation for 148 countries in 2013. The OECD countries average 0.964, Latin American and the Caribbean, 0.963, South Asia, 0.860, Arab countries, 0.866, and sub-Saharan African countries 0.867. A number of countries have scores higher than 1 because of some combination of higher female education achievement than males and female life expectancy exceeding that of males by more than five years.

B. Gender Inequality Index

The UNDP also developed another measure of gender inequality, the GII, which is based on three components: female reproductive health, women's empowerment, and labor market variables (Gaye, Klugman, Kovacevic, Twigg, and Zambrano, 2010; UNDP, 2014b). The health dimension is measured with two indicators: the maternal mortality ratio and adolescent fertility rate, for ages 15 to 19. The Gaye et al. (2010) study argues in favor of the use of the maternal mortality ratio because improvement in this ratio is a global policy priority (for instance, under the MDGs), and provides a clear indication of women's access to health. The adolescent fertility rate is included to capture both the detrimental consequences and risks associated with early child bearing, which include poorer living standards, lower monthly income, reduced child nutrition, and lower educational achievements and economic outputs for teenage mothers (Gaye et al., 2010).

[21] Our calculation suggests this estimate is high.

The empowerment component consists of women's political representation and educational attainment at secondary and higher levels. Women's political representation is measured by the share of female seats in national parliaments. Lastly, the GII contains the ratio of female and male labor force participation rates, instead of estimates of earnings, to capture gender inequality in economic activity.

In contrast to the GDI, the GII combines both well-being and empowerment measures in the index. Although both indices share education, health, and labor market variables, none of the specific measures overlaps. Moreover, unlike the GDI, the GII includes variables on health for which there are no male counterparts. The GII also has a political variable, which is absent in the GDI.

The GII relies on aggregation into female and male indices, much as in the GDI. But the precise method of aggregation is different. Each index is calculated separately for men and women using a geometric mean across dimensions, and then aggregated using a harmonic mean across genders. The final calculation relies on the gap between 1 and the ratio of the calculated harmonic mean based on actual data and a reference standard that assumes females and males are equal (where norms are established for the indicators unique to females). In contrast to the GDI, the GII has a lower value when women and men are more equal and a higher value when they are more unequal.[22]

The GII addresses some of the problems identified by researchers with the old GDI in that it uses data on labor force participation in place of wage data and a weighting based on a geometric mean. Nonetheless, Klasen and Schüler (2011), Klasen (2014) and Permanyer (2013) criticize the GII on a number of grounds. It now mixes a measure of well being with empowerment, a feature of some of the other indices as well. Furthermore, it combines progress in female-only variables (maternal mortality and adolescent fertility) with gender gap variables, which biases the index against poor countries. In their view, the construction of the index is unnecessarily complex, which limits intuition and transparency. Klasen (2014) also notes that an important driver of the index's value is maternal mortality, a variable with poor data quality. He concludes that the revised GDI is a better measure of gender parity and proposes strengthening the GII by separating the well being and empowerment measures, focusing the well-being measures on indicators closely related to the HDI and dropping the indicators that are unique to women, and simplifying the construction of the index.

[22] Permanyer (2013, p. 7) points out that the developers of the GII fail to recognize that because there are some variables in the index for women only, the index will not take a value of 0 when men and women are equal in other dimensions.

C. Gender Equality Index

The GEI was developed as an indicator of gender inequality, as one of five social indices constructed by the International Institute of Social Studies at Erasmus University in the Netherlands.[23] It was first published in 2010. The GEI includes 21 indicators from six different sources. The data include both quantitative and qualitative measures and two indicators are composites, namely women's economic rights and women's social rights. Van Staveren (2013, pp. 343-44) provides an overview of the indicators in the GEI. The index is novel in using attitudinal indicators whose data derive from cross-national surveys such as the World Values Surveys (Foa and Tanner, 2012). The GEI is also unique methodologically. Instead of depending on averages for aggregation, the index depends on a matching percentiles method, which is useful for addressing missing values (Van Staveren, Webbink, de Haan, and Foa, 2014, p. 15). The values generally range from 0 to 1 where a higher number implies more equal gender relations, similar to the GDI. Like the GDI and GII, it has wide country coverage. However, unlike these indices, the female to male ratios are capped at equality, so that female disadvantage does not offset female advantage in another variable.

D. Global Gender Gap Index

The GGGI was introduced in 2006 (WEF, 2014). Using female to male ratios, it includes 14 separate indicators of gender gaps in five areas: educational attainment, health and well being, economic participation and opportunity, and political empowerment. The results are truncated at an "equality" benchmark of 1, except life expectancy, whose benchmark is set at 1.06 and sex-ratio at birth, whose benchmark is set at 0.944, thus making this index, like the GEI, a measure of female disadvantage.

The construction of the GGGI involves calculating each sub-index and aggregating the sub-indices to obtain the final GGGI values. In computing a sub-index, all indicators are averaged with weights based on the standard deviations of a one percentage point change of each component to ensure that each indicator is given the same relative impact on the sub-index. The index calculation relies on an unweighted average of the four sub-indices. It is increasing in gender equality. This index combines both well being and empowerment indicators. Klasen and Schüler (2011) and Hawken and Munch (2013) suggest that the large number of components and complex weighting procedures (and varying weights over time) raise questions regarding interpretation and comparability of the index over time.

[23] Social Watch has also developed a Gender Equity Index, which we do not review here but is discussed in Gaye et al. (2010) and Hawken and Munck (2013).

E. Social Institutions and Gender Index

The SIGI was introduced in 2010 to focus on the role of social institutions as a key aspect explaining the origins of gender inequality, and in part as a response to GDI as a highly outcome-oriented measurement (Branisa, Klasen, and Ziegler, 2013; OECD, 2014a). The underlying idea is that it is essential to understand human behaviors and social institutions that cause gender inequality and that rankings derived on these underpinnings rather than outcomes of gender bias are informative.

The 2014 version of this index draws upon data from the OECD's Gender, Institutions, and Development database. The index divides sources of gender inequality in social institutions into five categories: discriminatory family codes, restricted physical integrity, bias toward sons, laws on restricted resources and assets, and restricted civil liberties. The family code component reflects social institutions in the household and family that restrict women's decision making power and undermine their status. The physical integrity component refers to social institutions that promote gender-based violence and increase women's vulnerability. The son bias captures unequal distribution of intra-household resources to female and male children. The resources and assets component encompasses discrimination in women's access and rights to natural and economic resources. Lastly, the civil liberties component measures discriminatory laws and practices that hinder women's participation in public life. Each of these five components is based on a few individual indicators and represents a separate sub-index.

The SIGI and its sub-indices take values from 0 to 1, from low or no inequality to high inequality, like the GII. It caps the measure of inequality and thus measures female disadvantage. The variables are aggregated within a sub-index using principal components analysis and then the sub-indices are aggregated by using squared values of each sub-index to incorporate inequality aversion. Branisa, Klasen, Ziegler, Drechsler, and Jutting (2014) and OECD (2014b) provide further details on the construction of the index.

The SIGI is innovative in attempting to capture gender bias in social institutions, but it is difficult to capture this bias fully because discrimination can often be context specific. Because of cultural, social and religious differences, there is no uniform set of indicators to identify gender discrimination on a global scale.

Although the squaring of the sub-indices was intended to give large gaps more attention, Van Staveren (2013) questions whether this gives excessive weight to components with large deviations from gender equality. A country with many small gaps might appear more equal than one with no gaps except in one area where the gap is significant. Absent a hierarchy of priority in eliminating gender gaps, it is unclear whether an approach that adds weight to the larger gap is more informative.

Hawken and Munck (2013) commend SIGI for its clear conceptual framework. However, they raise concerns about the construction of the index scales and the combining of indicators in the sub-indices that entails a comparison of females and males and those that involve only women. Finally, they note that like the GGGI, the weighting scheme is data driven, though in the case of SIGI, higher weights are assigned to indicators that correlate more, which can be questioned on theoretical grounds.

F. Women's Economic Opportunity Index

The WEOI, an index of women's progress on economic advancement, was introduced in 2006 (EIU, 2012). It has a somewhat different orientation than the other measures in that it captures gender discrimination in paid economic activities as well as the women's ease of doing business. It involves five categories: labor policy and practice, access to finance, education and training, women's legal and social status, and the general business environment, with a total of 29 indicators. The rankings are constructed from an average across the indicators. Its values range from 0 to 100, with a higher number implying more equal gender relations. Like the GDI and GII, this index allows compensation of female advantage with female disadvantage, thus making this index a measure of women's opportunity compared to men's.

G. Relative Status of Women and Gender Gap Measure Indices

Dijkstra (2002; 2006) and Dijkstra and Hanmer (2000) propose a gender equality index, the Relative Status of Women, which makes use of the HDI indicators and takes the ratio of female to male levels in education, life expectancy, and earnings, sums them, and divides by 3. A value less than 1 implies bias against women and a value greater than 1 implies bias against men. Thus, like the GDI and GII, it does not cap differences and so is a measure of inequality, not bias against women. The income variable, as in the GDI, has the highest variation and thus drives the results, a problem which can be addressed by introducing a weighting scheme.

Klasen and Schüler (2011) propose a variation termed the Gender Gap Measure (GGM) which takes the same basic construction but replaces earnings with labor force participation and uses the geometric rather than arithmetic mean. The revised GDI adopts this idea in taking a ratio of females to males, though it continues to rely on income rather than labor force participation.

H. Quantitative Comparison of the Gender Equality Indices

The previous section has shown diversity among the gender indices in their focus, use of indicators, and methodology of aggregation. This section compares the indices in a quantitative manner. Table 2 provides a correlation matrix, using Pearson's correlations

between the gender indices. The indices are well correlated with each other, which is not surprising, given that they all measure gender equality. However, none is perfectly correlated, consistent with their differences in focus and construction. The negative numbers for the GII and SIGI reflect that these indices are increasing in more inequality while the others are increasing in more equality.

Table 2. Correlation Between the Gender Equality Indices

	GDI	GEI	GGGI	GII	SIGI	WEOI
GDI	1					
GEI	0.90***	1				
GGGI	0.79***	0.76***	1			
GII	-0.69***	-0.74***	-0.53***	1		
SIGI	-0.75***	-0.81***	-0.69***	0.69***	1	
WEOI	0.71***	0.76***	0.62***	-0.88***	-0.74***	1

Sources: See appendix C, table 1. The latest data available for each index are used.

*** Indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

By way of contrast, Table 3 presents the correlation matrices for some of the individual gender indicators, for the full sample, with variables measured the same as in the analysis of the figures. We find that the correlation between individual indicators is significantly lower than for the indices. This difference does suggest that as summary measures of gender inequality, the indices serve a purpose. However, for a particular focus of analysis, the individual indicator may be more meaningful and appropriate.

V. Extension of the UNDP's Gender Equality Indices Backward in Time

Because the gender equality indices are not constructed consistently over time, it may be misleading to look at the evolution of a country's rating without taking into account how the construction of the index or data have changed over time. Neither of the UNDP's indices has a long time series for the reasons discussed: the GDI is a new construct of the older series and the GII was relatively recently introduced. Consequently, we have constructed time consistent (or TC) versions of the UNDP's GDI and the GII.[24] Appendix D provides more details on the construction of these indices and how they differ from the UNDP's own calculations. We aggregate the indices on a regional, population-weighted basis to provide a consistent comparison of the evolution of the indices in relation to the individual indicators.

[24] Dilli, Rijpma, and Carmichael (2015) and Gonzales, Jain-Chandra, Kochhar, Newiak, and Zeinullayev (2015) also replicate gender indices backward in time in a consistent manner. We term our replications "TC" to signify that they are time consistent and to distinguish them from the UNDP's own indices.

Table 3. Correlation Between the Indicators

	Gross secondary enrollment		Life expectancy (at birth)		Maternal mortality ratio		Labor force participation (ages 15-64)		Share of female parliamentarians		Child mortality, under the age of 5	
	All countries	LIDCs	All countries	LIDCs	All countries	LIDCs	All countries	LIDCs	All countries	LIDCs	All countries	LIDCs
Gross secondary enrollment	1	1										
Life expectancy (at birth)	0.19**	-0.01	1	1								
Maternal mortality ratio	-0.58***	-0.55***	-0.43***	-0.37**	1	1						
Labor force participation (ages 15-64)	0.02	0.15	0.15	0.07	0.09	0.16	1	1				
Share of female parliamentarians	0.13	0.24	-0.08	-0.05	-0.03	0.14	0.37***	0.31*	1	1		
Child mortality, under the age of 5	-0.41***	-0.41**	-0.60***	-0.69***	0.45***	0.63***	-0.24**	-0.08	-0.14	0.17	1	1

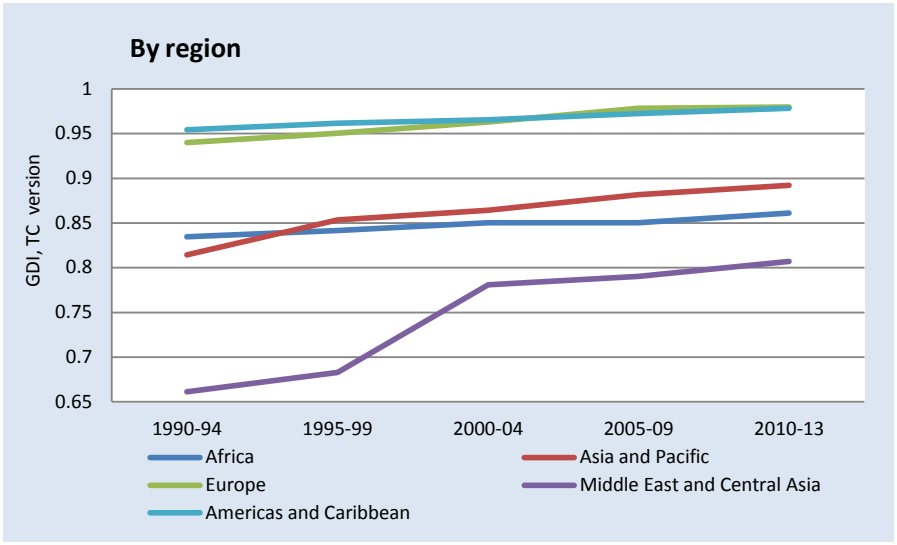
Sources: World Bank, World Development Indicators database; and IMF staff estimates.
*** Indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

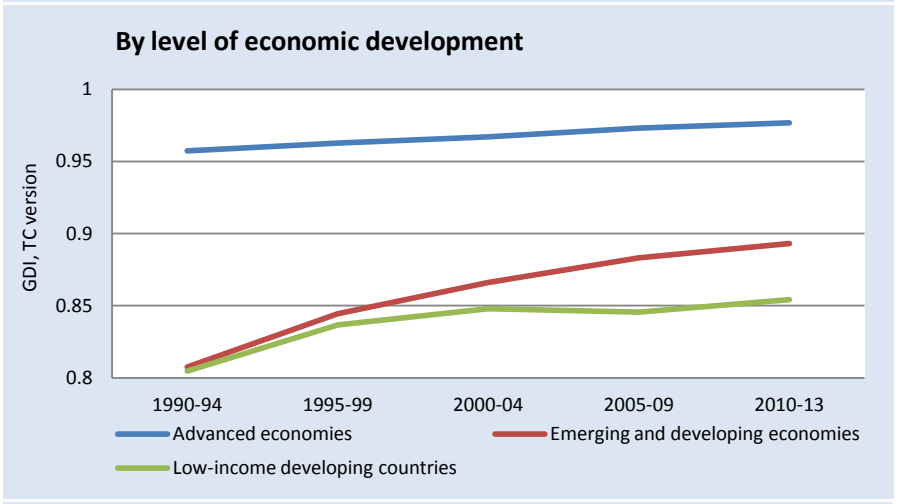
Figure 11shows the evolution of the GDI, TC version, over time and by region. Each of the regions shows a trend toward greater gender equality, which is consistent with the trends for the individual indicators. Gender equality in the Middle East and Central Asia considerably lags the other regions. Sub-Saharan Africa's gender equality only improves modestly over time. The Asia and Pacific region, which in the early part of the sample has lower equality than sub-Saharan Africa, surpasses it by sample end. The Middle East and Central Asia shows a pronounced upward movement in the middle years, suggestive of some genuine changes but also the addition of the Central Asian countries, whose gender equality indicators tend to be somewhat higher than those for the region as a whole. The same trends of steady improvement are shown in the breakdown by income level and for the LIDCs. The emerging market countries make the most significant improvement, starting from a relatively weak position.

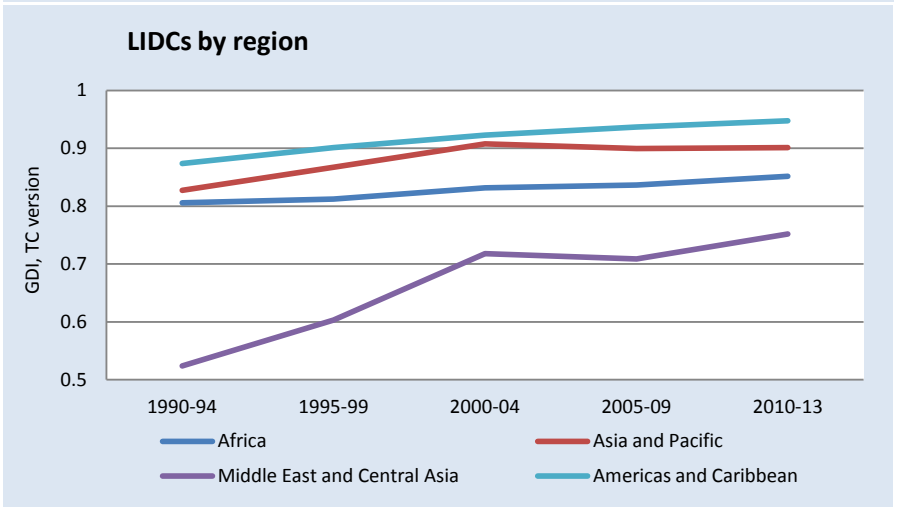
The same general results are observed in Figure 12, which shows the evolution of the GDI, TC version, with labor force participation replacing relative wages in the index. One notable difference with the version based on wages is that sub-Saharan Africa does relatively better and the Middle East and Central Asia relatively worse, because of the relatively high rate of female labor participation in sub-Saharan Africa and low rate of participation in the Middle East and Central Asia. This difference, compared to the version of the index with wages, is also reflected in the chart showing disaggregation by income level because most of the low-income countries are in sub-Saharan Africa.

Figure 13 provides the same trends with the GII, TC version. The y axis is inverted because, in contrast to the GDI, an increasing GII indicates higher gender inequality. The same trend of improving gender equity across the regions is observed. There are two notable contrasts with the GDI (either version) when looking at the chart with a breakdown by region. In contrast to the GDI, the GII values for the Middle East and Central Asia and the sub-Saharan Africa regions show roughly the same degree of gender equality, with the Middle East and Central Asia starting a bit worse on gender inequality but showing a better index value than sub-Saharan Africa by sample end. There are a number of key differences in variables and aggregation methodologies between the two indices that would account for this difference. The GII, in contrast to the GDI, contains measures of maternal mortality and adolescent fertility, on which sub-Saharan countries fare poorly compared to the rest of the world including the Middle East and Central Asia (as shown in Figure 6). However, there are some countervailing factors that would bolster the relative performance of sub-Saharan Africa, including the high relative degree of female labor force participation and political representation. Across all regions, sub-Saharan Africa has the highest ratio of female to male labor force participation and highest rate of female labor force participation. Similarly, in contrast to the GDI, the Americas and Caribbean have more gender inequality than Europe, also reflecting the Western Hemisphere's significantly weaker performance on maternal mortality and adolescent fertility, and a somewhat larger gap in labor force participation.

Figure 11. GDI, TC Version

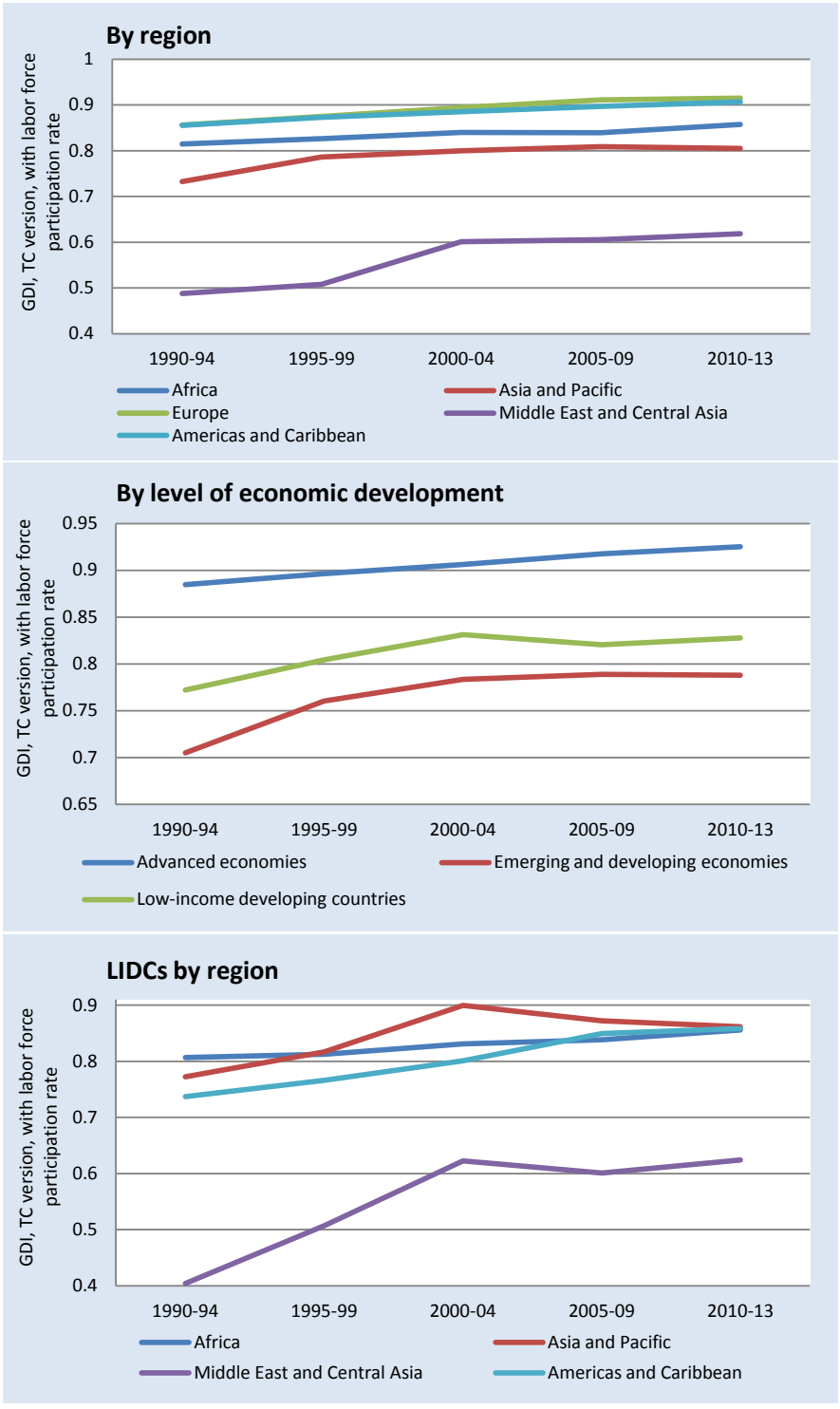






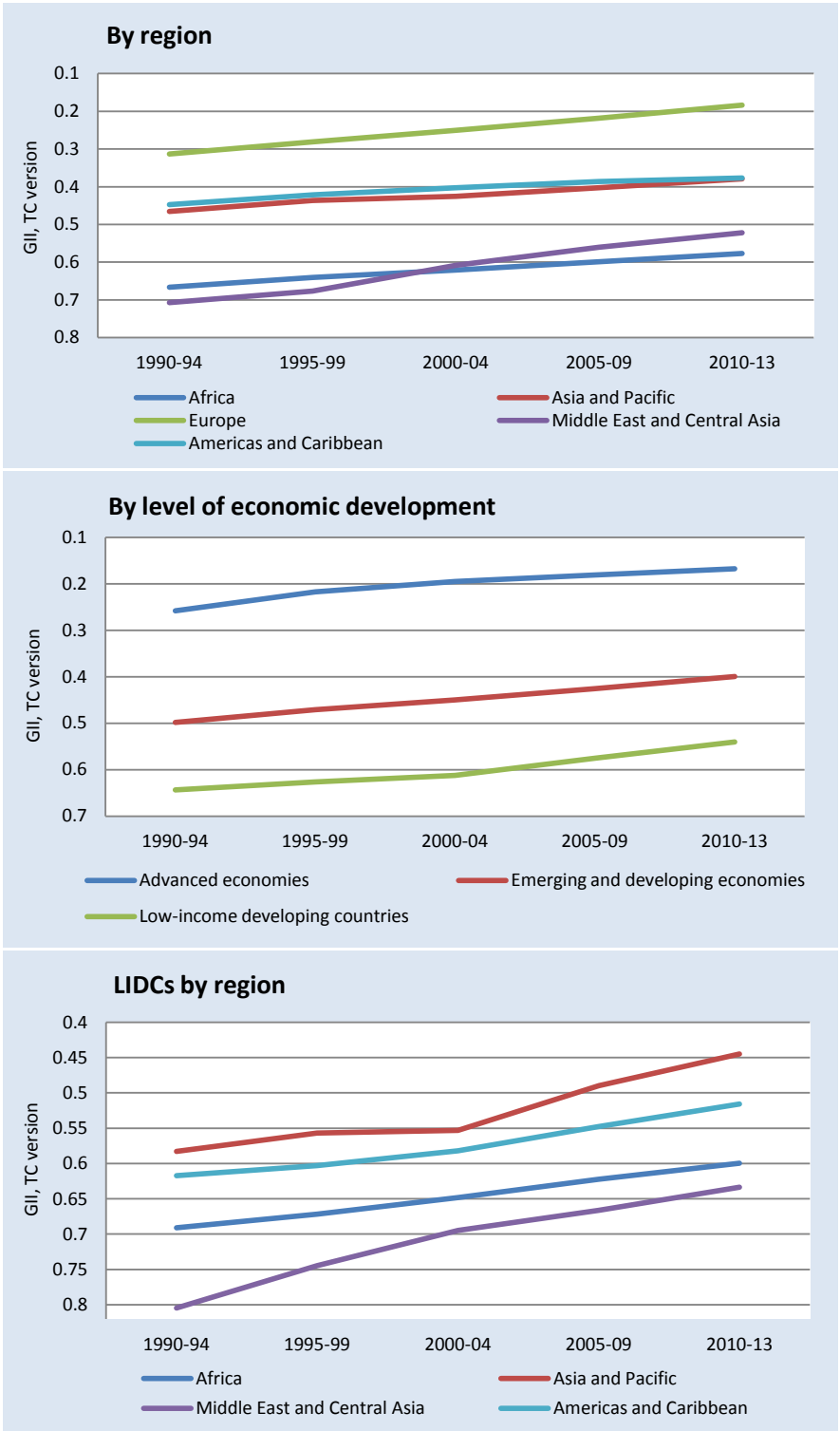
Sources: Barro and Lee; ILO, ILOSTAT; World Bank, World Development Indicators database; and IMF staff estimates.

Figure 12. GDI, TC Version, with Labor Force Participation Rate



Sources: Barro and Lee; ILO, ILOSTAT; World Bank, World Development Indicators database; and IMF staff estimates.

Figure 13. GII, TC Version



Sources: Barro and Lee; World Bank, World Development Indicators database; and IMF staff estimates.

VI. Relationship of the Gender Equality Indices to Income

One of the goals in constructing alternative measures of the gender equality indices was to address criticisms that because of the high correlation between measures of income and the indices, these indices were largely a proxy for income rather than measuring something independent. We present in Table 4 some simple ordinary least squares (OLS) regressions to assess the degree of dependence of the indices on income. Using the latest year of data for each index, we run a regression of the index on the natural log of GDP per capita. The results show that for each index, higher income is strongly correlated with an improved measure of gender equality (and note the sign is reversed on the GII and SIGI because they are constructed so that a higher index number implies more gender inequality). There is a considerable degree of variation in the overall explanatory power of the OLS regressions. Comparing the two UNDP indices, the regression with the GII as dependent variable shows that income alone leads to high explanatory power of the regression, while the regression with the GDI shows somewhat lower, though still high, explanatory power. These results suggest that the gender indices remain highly dependent on variables that vary with country income level, and are therefore to some degree confounding gender equality and standard of living in what they represent and should be used with care in aggregate level regressions.

Table 4. Regression of Gender Equality Indices on Per Capita Income

OLS Regression with Cross-Section Data

	GDI	GEI	GGGI	GII	SIGI	WEOI
ln GDP pc	0.0368***	0.0599***	0.0139***	-0.126***	-0.0729***	12.23***
	(0.00403)	(0.00824)	(0.00519)	(0.00898)	(0.0102)	(0.940)
Constant	0.593***	0.194***	0.564***	1.535***	0.814***	-58.44***
	(0.0396)	(0.0730)	(0.0484)	(0.0805)	(0.0913)	(8.451)
Observations	146	177	127	149	99	126
R-squared	0.391	0.266	0.077	0.637	0.318	0.643

Notes: Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

In Table 5, we present cross-section time-series results using the TC versions of the GDI and GII. Using OLS with cross-section fixed effects added to control for country-specific factors, we obtain the same results as in the cross-section analysis, although the coefficient on income for both indices increases in absolute value. With a specification that involves first differencing the variables,[22] we obtain the result that income remains positive and significant for the GDI, but

[22] We split the sample using the World Bank income group classification and then test for unit roots using the Levin, Lin, and Chu and Im, Pesaran, and Shin panel unit root tests in Stata. We do not reject the null of a unit root. We

(continued)

loses its significance in the GII, highlighting the importance of specification in understanding these relationships.

Table 5. Regression of TC Version of Gender Equality Indices on Per Capita Income

	OLS with Cross-Section Fixed Effects			OLS in First Differences	
	GDI, TC	GII, TC		Δ GDI, TC	Δ GII, TC
ln GDP pc	0.0676***	-0.157***	Δ ln GDP pc	0.00831**	-0.00501
	(0.00204)	(0.00415)		(0.00420)	(0.00611)
Constant	0.296***	1.847***	Constant	0.00207***	-0.00655***
	(0.0185)	(0.0375)		(0.000134)	(0.000389)
Observations	2,776	3,000	Observations	2,591	2,858
R-squared	0.295	0.333	R-squared	0.009	0.000
Number of countries	151	138			

Notes: Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

VII. Uses of the Indicators and Indices for Policy Analysis and Decision Making

Both individual indicators on gender equity and women's advancement and gender equality indices play an important role in providing information on trends and comparison across countries and over time.

Individual indicators remain most useful, where analysis has a specific focus on an area to which the indicator directly relates. Although some individual indicators have data deficiencies, they have the distinct advantage of being straightforward to understand and interpret. International initiatives are working to improve and expand the coverage of key indicators on education, health, and economic and political opportunities and outcomes, which will be critical in improving their information content.

As a summary statistic of a country's status on gender equity, the gender equality indices play a useful role. The variety of gender indices suggests that it is important to understand their strengths as a summary indicator of many dimensions of gender equality but also their limitations in that the results are dependent on the choice of variables, and weighting and

next test for a cointegrating relationship among the variables using Pedroni panel cointegration tests and reject the null of no cointegration. Finally, we run panel dynamic OLS regressions and find that the results vary by income group. The results are available from the authors upon request.

aggregation schemes. The absence of a consistent time series limits their use for trend analysis. One important contribution of this paper is constructing a consistent version of the UNDP's GDI and GII indices (with some modification) backward over time so that the trends reflect changes in the underlying variables rather than methodological changes. The differences between the trends with the GDI and GII point out the importance in understanding the factors that drive the measurement of gender equality in the index. We share the view in Klasen (2014) that a good index should be relatively simple and transparent and that the UNDP's new GDI is a step forward. Klasen lays out some useful proposed modifications of the GDI. We have illustrated some sensitivity to the methodology, in line with these comments. We agree with a number of assessments that an index is stronger when it does not mix measures of well being with empowerment, thus suggesting that the GDI may be a more reliable indicator of gender equality than the GII, even if the GII may have advantages as an indicator of overall well being. The GII's weight on maternal mortality and adolescent fertility, neither of which has a male counterpart, is certainly one major limitation of the index as a measure of gender equality. An index should also be robust to minor changes in the variables included in the aggregation and the weighting and aggregation methodology to be credible. Ideally, the construction of the index should be consistent over time.

With the focus on gender equality on the international stage and the explicit incorporation of gender equality goals in the newly adopted SDGs, governments should make greater use of indicators and gender equality indices to guide their decision making. Their ability to measure outcomes means that they are vital in providing input to budget and other decision making processes to formulate public policies that will help close the gender gap and advance women's well being worldwide.

VIII. Conclusion

This paper surveys trends in key gender-related indicators and indices of gender equality. It adds to the literature on gender equality indices two new versions of the UNDP's GDI and GII, constructed in a consistent manner backward in time, to permit a more accurate view of time trends.

This paper presents trends in individual indicators on education, health, and economic and political opportunity and achievement, weighted by population, and disaggregated by region and level of development. These trends suggest that the world is making progress in gender equality and women's development. Although gender inequalities remain, women have made significant progress in closing education gaps and in some aspects of health, including those unique to women such as maternal mortality. Women are making progress in closing economic and political gaps, as well, though they remain significant. Certain regions of the world continue to lag in indicators of gender equality and women's advancement, especially South Asia, sub-Saharan Africa and the Middle East and Central Asia. Advanced countries also tend to present better outcomes, though emerging countries have made significant strides in key education and health outcomes, and in some areas, such as labor force participation or political participation,

LIDCs may also achieve reasonable comparability. The trends suggest that each indicator is evolving at its one pace, which varies across the world and levels of development. One important result is that countries can make significant progress in closing gender gaps and in women's advancement on critical indicators, even while significant income differences remain.

Indices of gender equality have proliferated in recent years and the thinking on how best to construct them has moved forward significantly. Although the indices differ in key respects, they permit a reasonable comparison of countries at a point in time, and for those constructed in a consistent way over time, they also permit time-series analysis. The picture they present is similar to that for the individual indicators, in part reflecting the significant overlap of indicators and those that are used to construct key indices. Advanced countries are generally doing better in terms of women's advancement and gender equality, but developing countries are making progress, at different rates. Interestingly, a comparison of the GDI and GII, TC versions, over time suggests some key differences in how regions perform in terms of gender equality, which makes it important in using these indices for analytical purposes to understand how they are constructed and what drives the results. All indices show a high degree of correlation with income, suggesting that some care should be used in aggregate level analysis to ensure that the indices are not proxying both for measures of gender equality and standard of living.

Both individual indicators and indices serve a useful purpose for policy makers in that they provide an objective view of how countries are doing. Policy makers can make use of the information contained in individual indicators and indices by using their evolution to evaluate the success of fiscal and other policies that should be linked to gains in gender equality and women's conditions of life.

Both indicators and indices have their advantages and disadvantages as a source of information. While indicators can be tied to specific policies more easily, they represent only one facet and indices are useful in presenting a broader picture. The coherence between the evolution of indicators and indices, presented in this paper, suggest both are useful in the appropriate context.

References

African Development Bank, 2015, *Empowering African Women: An Agenda for Action* (Abidjan: African Development Bank).

Agenor, Pierre-Richard and Otaviano Canuto, 2015, "Gender Equality and Economic Growth in Brazil: A Long-Run Analysis," *Journal of Macroeconomics*, Vol. 43, pp. 155-172.

Bardhan, Kalpana, and Stephan Klasen, 1999, "UNDP's Gender-Related Indices: A Critical Review," *World Development*, Vol. 27, pp. 985-1010.

Bardhan, Kalpana, and Stephan Klasen, 2000, "On UNDP's Revisions to the Gender-Related Development Index," *Journal of Human Development*, Vol. 1, pp. 191-5.

Barro, Robert, and Jong-Wha Lee, 2014, *Educational Attainment Dataset* (Seoul: Korea University).

Bauer, Gretchen, 2013, "Gender Quotas and Women's Representation in African Parliaments," *Democracy in Africa blog*, available online.

Bertrand, Marianne, 2011, "New Perspectives on Gender," in *Handbook of Labor Economics*, Orley Ashenfelter and David Card, editors (Amsterdam: Elsevier), pp. 1543-90.

Branisa, Boris, Stephan Klasen, and Maria Ziegler, 2013, "Gender Inequality in Social Institutions and Gendered Development Outcomes," *World Development*, Vol. 45, pp. 252-68.

Branisa, Boris, Stephan Klasen, Maria Ziegler, Denis Drechsler, and Johannes Jütting, 2014, "The Institutional Basis of Gender Inequality: The Social Institutions and Gender Index (SIGI)," *Feminist Economics*, Vol. 20, pp. 29-64.

Buvinic, Mayra, Rebecca Furst-Nichols, and Gayatri Koolwal, 2014, *Data2X: Mapping Gender Data Gaps*, United Nations Foundation.

Casarico, Alessandra, and Paola Profeta, 2015, "Introduction to the Special Issue 'The Determinants of Gender Gaps,'" *CESifo Economic Studies*, Vol. 61, pp. 1-6.

Chant, Sylvia, 2006, "Re-thinking the 'Feminization of Poverty' in Relation to Aggregate Gender Indices," *Journal of Human Development*, Vol. 7, pp. 201-20.

Clinton Foundation and Gates Foundation, 2015, *No Ceilings: The Full Participation Report*.

Das, Sonali, Sonali Jain-Chandra, Kalpana Kochhar, and Naresh Kumar, 2015, "Women Workers in India: Why So Few Among So Many?" International Monetary Fund Working Paper, 15/55 (Washington, DC: IMF).

Dijkstra, A. Geske, and Lucia C. Hanmer, 2000, "Measuring Socio-Economic Gender Equality: Towards an Alternative for UNDP'S GDI," *Feminist Economics*, Vol. 6, pp. 41-75.

Dijkstra, A. Geske, 2002, "Revisiting UNDP's GDI and GEM: Towards an Alternative," *Social Indicators Research*, Vol. 57, pp. 301-38.

Dijkstra, A. Geske, 2006, "Towards a Fresh Start in Measuring Gender Equality: A Contribution to the Debate," *Journal of Human Development*, Vol. 7, pp. 275-83.

Dilli, Selin, Auke Rijpma, and Sarah G. Carmichael, 2015, "Achieving Gender Equality: Development versus Historical Legacies," *CESifo Economic Studies*, Vol. 61, pp. 301-34.

Economist Intelligence Unit, 2012, *Women's Economic Opportunity Index 2012*, EIU, August 23.

European Institute for Gender Equality, 2015, *Gender Equality Index 2015-Measuring Gender Equality in the European Union, 2005-2012* (Italy, EIGE).

Fernandez, Raquel, and Alessandra Fogli, 2009, "Culture: An Empirical Investigation of Beliefs, Work, and Fertility," *American Economic Journal: Macroeconomics*, Vol. 1, pp. 146-77.

Foa, Robert, and Jeffery Tanner, 2012, *Methodology of the Social Development Indices*, International Institute for Social Studies Working Paper No. 2012-4 (Hague: IISS).

Folbre, Nancy, 2006, "Measuring Care: Gender, Empowerment, and the Care Economy," *Journal of Human Development*, Vol. 7, pp. 183-99.

Gaye, Amie, Jeni Klugman, Milorad Kovacevic, Sarah Twigg, and Eduardo Zambrano, 2010, *Measuring Key Disparities in Human Development: The Gender Inequality Index*, Human Development Reports Research Paper 2010/46 (New York: UNDP).

Gonzales, Christian, Sonali Jain-Chandra, Kalpana Kochhar, Monique Newiak, and Tlek Zeinullayev, 2015, "Catalyst for Change: Empowering Women and Tackling Income Inequality," International Monetary Fund Staff Discussion Note 15/20 (Washington, DC: IMF).

Grown, Caren, 2008, "Indicators and Indexes of Gender Inequality: What Do They Measure and What Do They Miss?" in *Equality for Women: Where Do We Stand on Millennium Development Goal 3?* Mayra Buvinic, Andrew R. Morrison, A. Waafas Ofosu-Amaah, and Mirja Soblom, editors (Washington DC: World Bank), pp. 93-145.

Hawken, Angela, and Gerardo L. Munck, 2013 "Cross-National Indices with Gender-Differentiated Data: What Do They Measure? How Valid Are They?" *Social Indicators Research*, Vol. 111, pp. 801-38.

International Food Policy Research Institute, 2012, *Women's Empowerment in Agriculture Index* (Washington, DC: IFPRI).

International Labor Organization, 2013, *ILOSTAT Database* (Geneva: ILO).

International Labor Organization, 2013, "India: Why Is Women's Labour Force Participation Dropping?" ILO News, February 13; downloaded May 14, 2015.

International Monetary Fund, 2014, *Proposed New Grouping in WEO Country Classifications: Low-income Developing Countries*, International Monetary Fund Policy Paper (Washington, DC: IMF).

Klasen, Stephan, 2004, "Gender-Related Indicators of Well-Being," Working Paper No. 102, Discussion Papers, Universitat Gottingen, Ibero-Amerika-Institute für Wirtschaftsforschung.

Klasen, Stephan, 2006a, "Guest Editor's Introduction," *Journal of Human Development*, Vol. 7, pp. 145-59.

Klasen, Stephan, 2006b, "UNDP's Gender-Related Measures: Some Conceptual Problems and Possible Solutions," *Journal of Human Development*, Vol. 7, pp. 243-74.

Klasen, Stephan, and Dana Schüler, 2011, "Reforming the Gender-Related Development Index and the Gender Empowerment Measure: Implementing Some Specific Proposals," *Feminist Economics*, Vol. 17, pp. 1-30.

Klasen, Stephan, 2014, "UNDP's Gender-Related Measures: Current Problems and Proposals for Fixing Them," unpublished manuscript.

Klasen, Stephan, and Janneke Pieters, 2015, "What Explains the Stagnation of Female Labor Force Participation in Urban India," *World Bank Economic Review*, Vol. 29, pp. 1-30.

Liu, Yan, Asuna Arai, Koji Kanda, Romeo B. Lee, Jay Glasser, Hiko Tamashiro, 2012, "Gender Gaps in Life Expectancy: Generalized Trends and Negative Associations with Development Indices in OECD Countries," *European Journal of Public Health*, Vol. 23, pp. 563-8.

Mithra, Pratha, and Sanaa Farid, 2013, "Female Labor Force Participation in MENAP," *Regional Economic Outlook, Middle East and Central Asia* (Washington, DC: International Monetary Fund), Box 1.3, p. 29.

Morrison, Andrew R., Shwetlena Sabarwal, and Mirja Sjoblom, 2008, "The State of World Progress, 1990-2007," in *Equality for Women: Where Do We Stand on Millennium Development Goal 3?* Mayra Buvinic, Andrew R. Morrison, A. Waafas Ofosu-Amaah, and Mirja Soblom, editors (Washington DC: World Bank), pp. 33-92.

Organization for Economic Cooperation and Development, 2014, *Social Institutions & Gender Index 2014: Synthesis Report* (Paris: OECD).

Organization for Economic Cooperation and Development, 2014, *Social Institutions & Gender Index: Methodological and Background Paper* (Paris: OECD).

Permanyer, Iñaki, 2013, "A Critical Assessment of the UNDP's Gender Inequality Index," *Feminist Economics*, Vol. 19, pp. 1-32.

Schüler, Dana, 2006, "The Uses and Misuses of the Gender-Related Development Index and Gender Empowerment Measure: A Review of the Literature," *Journal of Human Development*, Vol. 7, pp. 161-81.

Thorslund, Mats, Jonas W. Wastesson, Neda Agahi, Marten Lagergren, and Marti G. Parker, 2013, "The Rise and Fall of Women's Advantage: a Comparison of National Trends in Life Expectancy at Age 65 Years," *European Journal of Aging*, Vol. 10, pp. 271-7.

United Nations Development Program, various years, *Human Development Report* (New York: Oxford University Press).

United Nations Development Program, 1995, *Human Development Report* (New York: Oxford University Press).

United Nations Development Program, 2014a, *FAQ Gender Development Index* (New York: United Nations).

United Nations Development Program, 2014b, *Technical Notes: Calculating the Human Development Indices - Graphical Presentation* (New York: United Nations).

United Nations Economic and Social Council, December, 2014, *Gender Statistics Report of the Secretary-General* E/CN.3/2015/21, December 17.

United Nations Educational, Scientific, and Cultural Organization, various years, Institute for Statistics, Data Centre.

United Nations, 2015, *Transforming our World: The 2030 Agenda for Sustainable Development*, A/RES/70/1.

UN Women, 2015, *Progress of the World's Women 2015-2016: Transforming Economies, Realizing Rights* (New York: United Nations).

Van Staveren, Irene, 2013, "To Measure Is to Know? A Comparative Analysis of Gender Indices," *Review of Social Economy*, Vol. 71, pp. 339-72.

Van Staveren, Irene, Ellen Webbink, Arjan de Haan, and Roberto Foa, 2014, "The Last Mile in Analyzing Wellbeing and Poverty: Indices of Social Development," *Forum for Social Economics*, Vol. 43, pp. 8-26.

World Bank, 1980-2014, World Development Indicators (Washington, DC: World Bank).

World Bank, 2011, *World Development Report 2012: Gender Equality and Development* (Washington, DC: World Bank).

World Economic Forum, 2014, *Global Gender Gap Report 2014* (Cologny: WEF).

Appendix A. Gender-Related Data[1]

This appendix provides information on data with specific disaggregation by sex, drawn from World Bank databases (whose primary sources are documented in each database). The data series are classified under five broad categories: economic opportunity, education, health, political opportunity, and violence against women. Table A1 lists the indicators under each of the categories, with a description of the earliest availability of the data and whether it was available on a sex-disaggregated basis.

Table A1. List of Gender Indicators

	Indicators	Start year [2]	Sex disaggregated? yes/not applicable
Economic opportunity			
1	Access to credit	-	Yes
2	Access to ICT, Internet, Mobile Banking	2008	Yes
3	Average number of hours spent on :		
	- unpaid child care	-	Yes
4	- unpaid domestic work	1990	Yes
5	- unpaid housework	-	Yes
6	Employees by category:		
	- Agriculture	1980	Yes
7	- Industry	1980	Yes
8	- Services	1980	Yes
9	Female-headed households	1990	Not applicable
10	Female professional and technical workers	2006	Not applicable
11	Firms with:		
	- Female top manager	2007	Not applicable
12	- Female participation in ownership	2003	Not applicable
13	- Women in managerial posts	-	Not applicable
14	Labor force participation rate (ages 15+)	1990	Yes
15	Labor force participation rate (ages 15-64)	1990	Yes
16	Land owners	-	Yes
17	Proportion of employed :		
	- who are employers	1990	Yes
18	- who are own account workers	1990	Yes
19	Wage equality ratio	-	Not applicable
20	Wage workers (percent)	1980	Yes
21	Youth unemployment	1991	Yes

[1] This appendix was prepared by Carla Intal.
[2] Data indicated with – are collected but not yet available.

Table A1. List of Gender Indicators continued

	Indicators, continued	Start year [2]	Sex disaggregated? Yes/not applicable
Education			
1	Completion rates		
	- Primary	1980	Yes
2	- Secondary	1980	Yes
3	Educational attainment		
	- Primary	2000	Yes
4	- Lower secondary	2000	Yes
5	- Post secondary	2000	Yes
6	- Upper secondary	2000	Yes
7	- Tertiary	2000	Yes
8	Gross enrollment rates:		
	- Primary	1980	Yes
9	- Secondary	1980	Yes
10	- Tertiary	1980	Yes
11	Net primary enrollment rate	1980	Yes
12	Female graduates in:		
	-Sciences	1998	Not applicable
13	-Social science, business and law	1998	Not applicable
14	-Engineering, manufacturing, and construction		
15	Survival rate to grade 5	1980	Yes
16	Youth literacy rate	1980	Yes
Health			
1	Adolescent fertility rate	1980	Not applicable
2	Births by skilled health worker	1984	Not applicable
3	Contraceptive prevalence	1980	Not applicable
4	Crude birth rate	1980	Not applicable
5	HIV prevalence	1990	Yes
6	Life expectancy	1980	Yes
7	Maternal mortality ratio	1990	Not applicable
8	Mean age at marriage	1980	Yes
9	Mortality rate, under-5	1980	Yes
Political opportunity			
1	Share of female judges	-	Not applicable
2	Female legislators, senior officials and managers	1987	Not applicable
3	Female police officers	-	Not applicable
4	Female seats in parliament and ministerial bodies	1990	Not applicable

Table A1. List of Gender Indicators continued

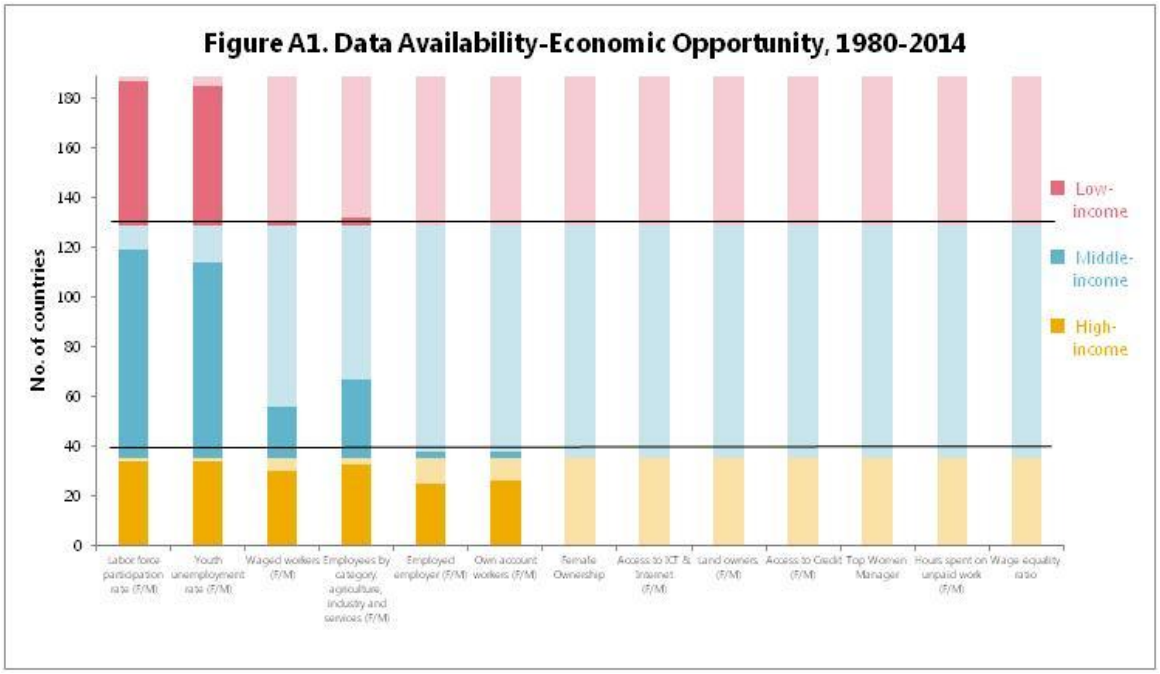
	Indicators, continued	Start year [2]	Sex disaggregated? Yes/not applicable
Violence against women			
1	Proportion of women aged 15-49 subjected to physical or sexual violence in the last 12 months		Not applicable
	- by an intimate partner (percent)	-	Not applicable
2	- by persons other than intimate partner (percent)	-	Not applicable
3	Women married at age 18	1986	Not applicable
4	Women who believe a husband is justified in beating his wife:		
	- when she argues with him (percent)	2000	Not applicable
5	- when she burns the food (percent)	2000	Not applicable
6	- when she goes out without telling him (percent)	2000	Not applicable
7	- when she neglects the children (percent)	2000	Not applicable
8	- when she refuses sex with him (percent)	1999	Not applicable
9	- any of the five reasons (percent)	2005	Not applicable

Sources: All data are obtained from the World Bank's databank.

Data availability

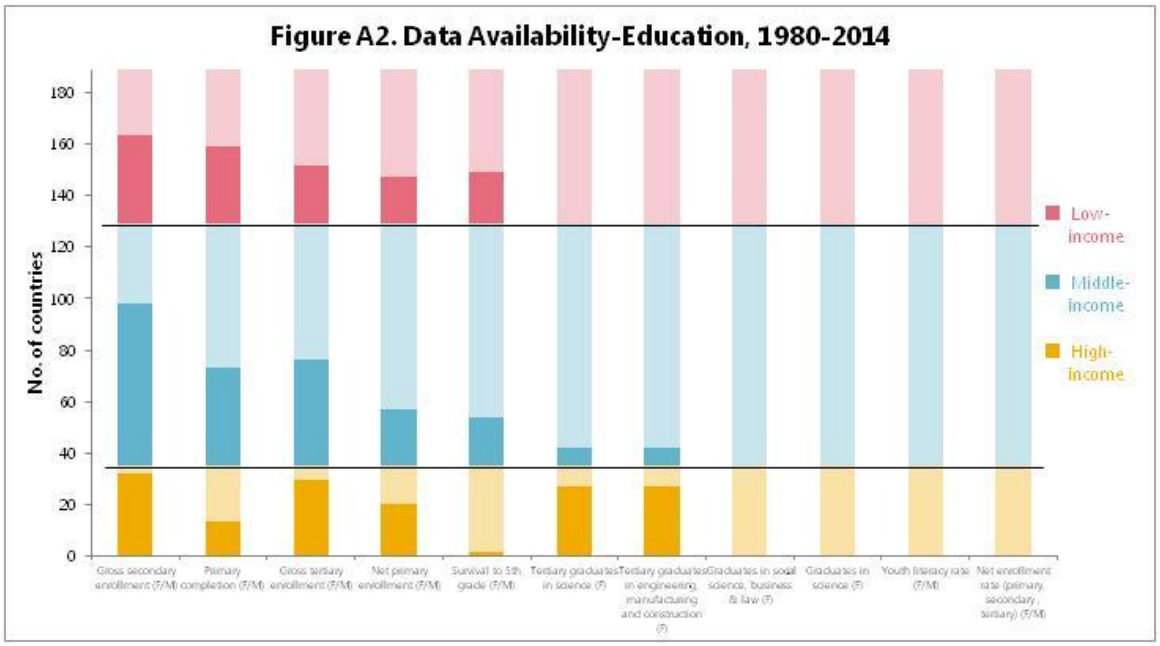
Below are snapshots of data coverage for certain key indicators of gender-related data, for 188 countries, grouped by their level of income. For each indicator, the data are treated as "available" if a country has at least 50 percent of the data for the years 1980-2014. While more indicators would have met the threshold if we had used a shorter time period or lower threshold, our preference was to encompass the period in which reforms in gender equality became a focus of international efforts. For each bar, a darker shade implies greater data availability for countries with at least 50 percent of the data. That is, a full dark bar indicates complete data coverage and a full light bar indicates no data coverage. Indicators are then ranked from left to right, by number of countries with 50 percent of the data available.

Of the 21 identified gender indicators for economic opportunity (Figure A1), only labor force participation rate and youth unemployment have significant global data coverage. Over 93 percent and 90 percent of countries have data on labor force participation rate and youth unemployment rate, respectively. Data coverage on low-income countries is particularly high for the two variables mentioned: out of 60 LIDCs, 58 countries have data for labor force participation rate and 56 countries have data for youth unemployment rate. Data coverage for other indicators—wage work, employment by category, female employers, and own account workers—are highly skewed towards high-income countries.



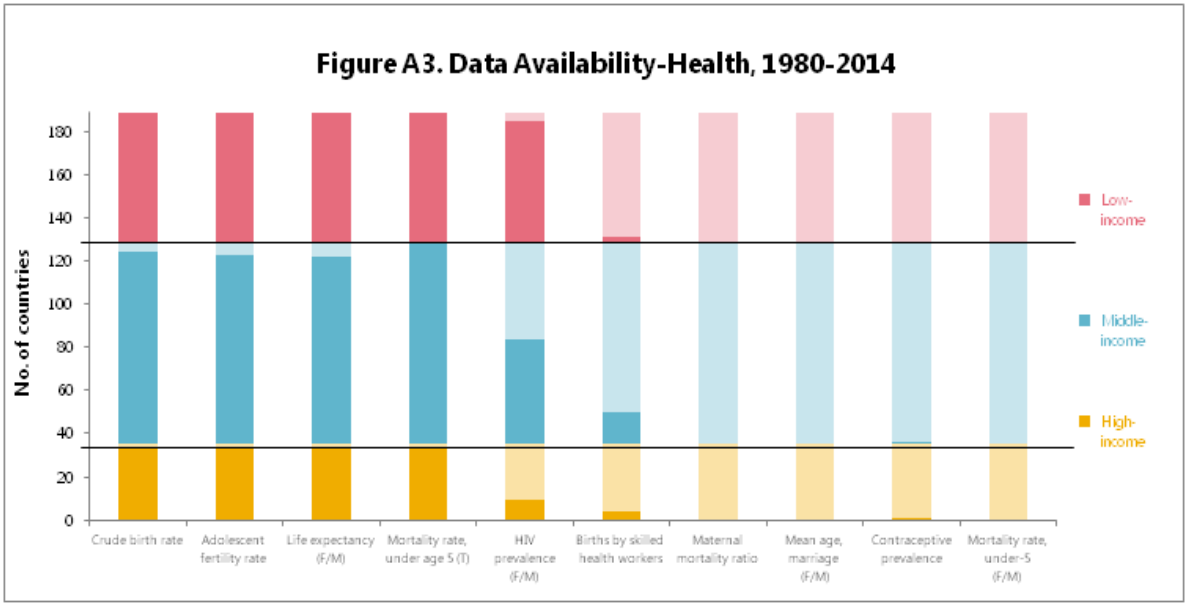
Sources: World Bank databank and IMF staff estimates.

Figure A2 shows that among education indicators, gross secondary enrollment has the highest coverage: 130 countries have data, accounting for 70 percent of the total. Of the LIDCs, 57 percent have data from 1980-2014. Aside from gross enrollment rates, the following indicators also have reasonable data coverage—primary completion rates, gross tertiary enrollment, net primary enrollment, and survival rate in school to grade 5.



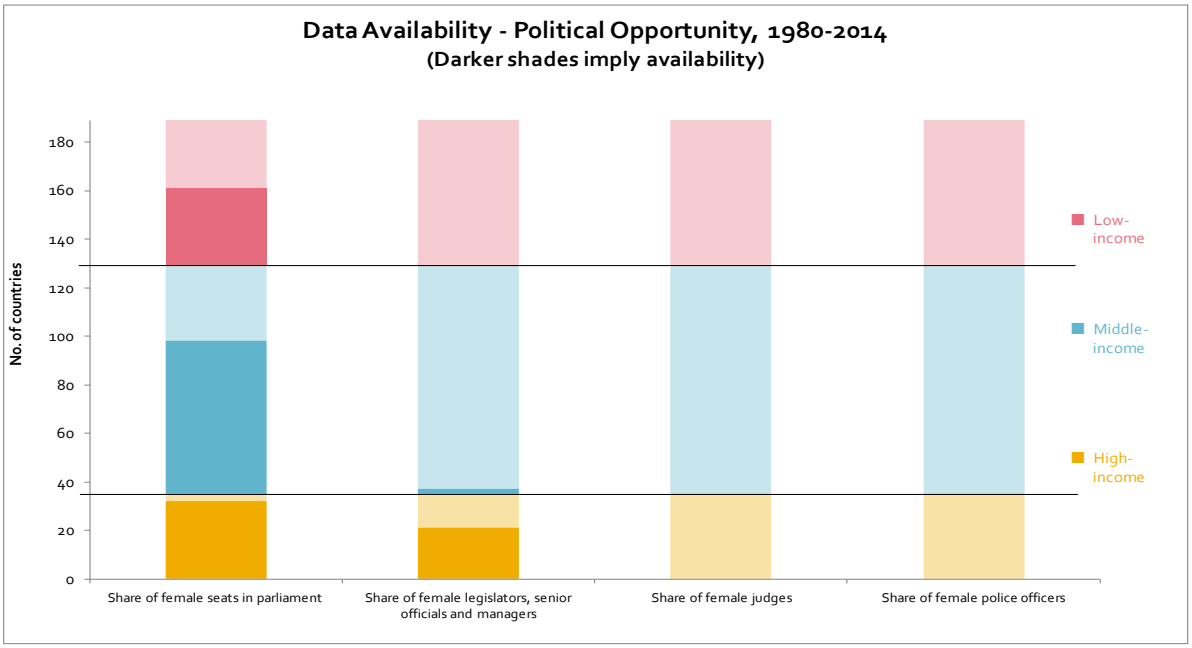
Sources: World Bank databank and IMF staff estimates.

Health indicators, where collected, have strong data coverage (Figure A3). Data for the first four indicators—crude birth rate, adolescent fertility rate, life expectancy, and under-5 mortality rate— are available in 97 percent of countries. Meanwhile, data on HIV prevalence is available for 56 out of 60 LIDCs. Maternal mortality data are available only every five years.



Sources: World Bank databank and IMF staff estimates.

Out of the four gender indicators for political opportunity (Figure A4), only the share of female seats in parliament has a reasonable amount of coverage globally: 127 out of 188 countries have reported data. Other indicators, namely, the share of female legislators, senior officials and managers, the share of female judges, and the share of female police officers, have scarce data availability.



Sources: World Bank databank and IMF staff estimates.

There are a number of initiatives on data underway, which have an exclusive or significant focus on improving gender-related statistics. We provide a list of these in Table A2 below.

Table A2. Data Initiatives

Initiative	Organization	Focus	URL
Women, Business and the Law	IFC, World Bank	Data collection, dissemination	http://wbl.worldbank.org/
Gender Equality Data Portal	World Bank	Data collection, organization, dissemination	http://datatopics.worldbank.org/gender/
Data2X	UN Foundation	Data and advocacy consultancy, dissemination	http://data2x.org/
Hunger Report	Bread for the World Institute	Advocacy, data visualization	http://hungerreport.org/missingdata/
No Ceiling	Clinton and Gates Foundations	Advocacy, data visualization	http://noceilings.org/about/
EDGE Initiative	UN Statistics Division	Data collection, dissemination	http://genderstats.org/EDGE
Gender Data Portal	OECD	Data collection, organization, dissemination	http://www.oecd.org/gender/data/
Gender and Land Rights Database	FAO	Data collection, dissemination	http://www.fao.org/gender-landrights-database/en/
World Policy Analysis Center	UCLA	Data collection, dissemination	http://worldpolicycenter.org/

Appendix B. List of Countries by Region and LIDC Classification

Table B1 provides a list of countries included in the sample of this study. Their regional classification is also presented below. Bolded countries indicate LIDCs.

Table B1. Countries and Their Classification

Africa	Asia Pacific	Europe	Middle East & Central Asia	The Americas & Caribbean
Angola	Australia	Albania	**Afghanistan**	Antigua and Barbuda
Benin	**Bangladesh**	Austria	Algeria	Argentina
Botswana	**Bhutan**	Belarus	Armenia	Bahamas, The
Burkina Faso	Brunei Darussalam	Belgium	Azerbaijan	Barbados
Burundi	**Cambodia**	Bosnia Herzegovina	Bahrain	Belize
Cameroon	China	Bulgaria	**Djibouti**	**Bolivia**
Cape Verde	Fiji	Croatia	Egypt	Brazil
Central African Republic	Hong Kong SAR	Cyprus	Georgia	Canada
Chad	India	Czech Republic	Iran	Chile
Comoros	Indonesia	Denmark	Iraq	Colombia
Congo, Dem. Rep.	Japan	Estonia	Jordan	Costa Rica
Congo, Rep. of	**Kiribati**	Finland	Kazakhstan	Dominica
Côte d'Ivoire	Korea, Rep.	France	Kuwait	Dominican Republic
Equatorial Guinea	**Lao PDR**	Germany	**Kyrgyz Republic**	Ecuador
Eritrea	Malaysia	Greece	Lebanon	El Salvador
Ethiopia	Maldives	Hungary	Libya	Grenada
Gabon	Marshall Islands	Iceland	**Mauritania**	Guatemala
Gambia, The	Micronesia, Fed. Sts.	Ireland	Morocco	Guyana
Ghana	**Mongolia**	Israel	Oman	**Haiti**
Guinea	**Myanmar**	Italy	Pakistan	**Honduras**
Guinea-Bissau	**Nepal**	Kosovo	Qatar	Jamaica
Kenya	New Zealand	Latvia	Saudi Arabia	Mexico
Lesotho	Palau	Lithuania	**Somalia**	**Nicaragua**
Liberia	**Papua New Guinea**	Luxembourg	**Sudan**	Panama
Madagascar	Philippines	Macedonia	Syrian Arab Republic	Paraguay
Malawi	Samoa	Malta	**Tajikistan**	Peru
Mali	Singapore	**Moldova**	Tunisia	St. Kitts and Nevis
Mauritius	**Solomon Islands**	Montenegro	Turkmenistan	St. Lucia
Mozambique	Sri Lanka	Netherlands	United Arab Emirates	St. Vincent and Grenadines
Namibia	Thailand	Norway	**Uzbekistan**	Suriname
Niger	Timor-Leste	Poland	West Bank and Gaza	Trinidad and Tobago
Nigeria	Tonga	Portugal	**Yemen**	United States
Rwanda	Vanuatu	Romania		Uruguay
São Tomé and Príncipe	**Vietnam**	Russian Federation		Venezuela
Senegal		San Marino		
Seychelles		Serbia		
Sierra Leone		Slovak Republic		
South Africa		Slovenia		
South Sudan		Spain		
Swaziland		Sweden		
Tanzania		Switzerland		
Togo		Turkey		
Uganda		Ukraine		
Zambia		United Kingdom		
Zimbabwe				

Appendix C. Data on Gender Indices

Table C1 provides details on each index discussed in the text, the developer, the source of data, whether published form or web link, the year of the data, corresponding to publications or available on the web, and country coverage in the latest variant of the data.

Table C1. Index Data Sources and Availability

Gender index	Developer	Publication date	Web link	Data year	Country coverage[1]
Old Gender-Related Development Index (GDI)[2]	UNDP	1995, 2000-2007/2008, 2009	http://hdr.undp.org/en/global-reports	1992, 1998-2005, 2007	194
Revised GDI[3]	UNDP	2014	http://hdr.undp.org/en/data	2013	148
Gender Inequality Index (GII)	UNDP	2014	http://hdr.undp.org/en/data	2008, 2011-2013	195
Gender Equality Index (GEI)	Institute of Social Studies, Erasmus University	Regularly updated	http://www.indsocdev.org/	Every 5 years, 1990 onward	209
Social Institutions and Gender Index (SIGI)	OECD	2009, 2012, 2014	http://genderindex.org/	2009, 2012, 2014	108
Global Gender Gap Index (GGGI)	World Economic Forum	2006-2014	http://reports.weforum.org/global-gender-gap-report-2014/	2006-2014	142
Women's Economic Opportunity Index (WEOI)	Economist Intelligence Unit	2010, 2012	http://graphics.eiu.com/upload/WEO_2012_v0.4.4_FINAL_FOR_PUBLIC_RELEASE.xls	2010, 2012	128

[1] The number of countries reflects the sample size for the latest listed year of data.
[2] The old GDI was discontinued after the 2007 index, which was reported in the 2009 Human Development Report.
[3] The revised GDI was introduced in the 2014 Human Development Report, using 2013 data.

Appendix D. Replication, Extension, and Revision of the GDI and GII

In this appendix, we provide details on the extension of the UNDP's new GDI and the GII back to 1990 and the sensitivity of the GDI index to replacement or re-estimation of some of the variables in the index, following suggestions by Klasen (2014) and Dijkstra (2002). We refer to our replicated and extended series as time consistent (TC) versions.

Construction of the GDI, TC version

The UNDP's newly introduced GDI begins in 2014, limiting the ability to do time series and panel data analysis with this index. Given that gender equality is a long-term objective and many of the index's indicators are available over a longer period, we have extended the series to provide a consistently constructed series. Dilli, et al. (2015) and Gonzales, et al. (2015) have done something similar, the former, with their own gender equality index and the latter, with the UNDP's GII. Table D1 provides information on the various indicators included in the GDI calculation. Although data for many of the indicators are available as far back as 1950, some indicators have limited data and, rather than impute data for variables other than wages, we extend the index back only to 1990.

Table D1. Overview of the Indicators Included in the GDI

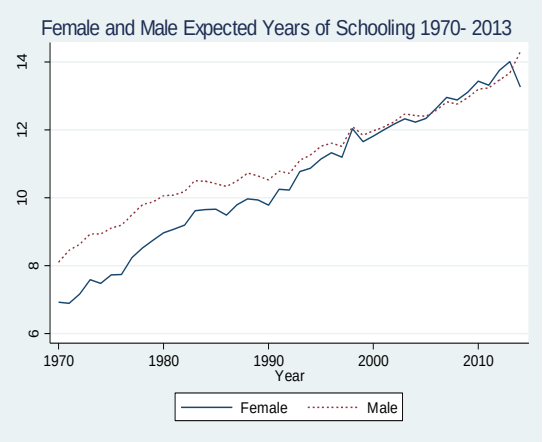
Indicator	Range	Mean (s.d.)	Countries[1]	Years	Source
Life Expectancy (F)	22.7-86.7	67.33 (11.25)	230	1960-2013	World Development Indicators, World Bank
Mean Years of Schooling (F)	0-13.64	5.67 (3.46)	156	1950-2012	Barro and Lee (2014) and UNESCO Institute for Statistics
Expected Years of Schooling (F)	0.36-20.84	10.77 (4.13)	101	1970-2013	UNESCO Institute for Statistics
Ratio of Female to Male Wage	0.41-1.5	0.77 (.12)	27	1995-2011	ILO
Female Share of Economically Active Population	0.096-0.56	0.40 (.095)	184	1990-2014	ILO
GNI per capita PPP (2011 $)	307-156,408	15,172.78 (19,408.85)	189	1980-2013	ILO
Population (F)	25.98-544,386.9	11,053.89 (41,981.62)	184	1980-2013	ILO

Sources: World Bank; Barro and Lee (2014); UNESCO; ILO; and IMF staff estimates. F refers to female.

[1] The number of countries reflects the sample size for the latest listed year of data.

The indicator expected years of schooling has limited availability across time.[2] For many countries, there might only be one observation available between the years 1970-2013. To include as many countries possible, the UNDP uses observations from as far back as 2002 to calculate the 2013 GDI. This is problematic when measuring gender equality because while expected years of schooling is an indicator that may not change drastically year by year, we see that the cumulative effect over a decade shows significant change in a country. Using data for all countries with at least two observations we calculate the average growth rate in expected years of education. We find the average yearly growth rate for expected years of schooling for females is 2.3 percent and for males 1.7 percent, while the average ten year growth rate is 16.8 percent for females and 11.4 percent for males. Figure D1 depicts the gender gap in expected years of schooling. From 1970-2013 we can see the gap narrowing; the two lines converge around 2000. Therefore using data from 1990 to represent a country's gap in 2000, for example, may not be an accurate representation. This raises the question of whether it is useful to include this indicator in the index at all.

Figure D1. Female and Male Expected Years of Schooling



Sources: UNESCO; and IMF staff estimates.

The UNDP uses two measures to create the "knowledge" sub-index: expected years of schooling and mean years of schooling. UNDP argues that it is necessary to include both measures of educational attainment because they measure educational attainment in two different age groups. Expected years of schooling refers to children and their chances of receiving education, while mean years of schooling refers to the adult population who have completed formal schooling. Yet there are other gender indices in which the educational attainment sub-index was limited to data on the adult population, namely the UNDP's Gender Inequality Index. Moreover expected years of education and mean years of education are highly correlated (with a correlation coefficient of about 0.9); thus, the benefit of including both indicators is minimal.

[2] Referred to by UNESCO as "School Life Expectancy: Primary to Tertiary."

Of all the indicators in the GDI, ratio of female to male wage has the poorest data coverage, with data on this indicator, in the year with highest data coverage, available for only 68 countries. Forty-four percent of the observations cover Europe and Central Asia, compared to only 0.6 percent of the observations for sub-Saharan Africa. Table D2 shows the regional distribution of data.

Table D2. Wage Data Coverage by Region

Region	Percent of Observations	Share of Population
East Asia and Pacific	15.9	33.7
Europe and Central Asia	43.9	14.1
Latin America and Caribbean	24.0	8.5
Middle East and North Africa	10.4	5.3
North America	1.8	5.4
South Asia	3.2	22.6
Sub-Saharan Africa	0.6	10.1

Sources: International Labor Organization; and IMF staff estimates.

To deal with the missing wage data, UNDP uses the global weighted wage ratio average of 0.8. This is a poor substitute for a number of reasons. First, Europe and Central Asia is over-represented in the sample based on population. Using the global average assumes that the wage ratio in countries with missing data is the same as the average in countries outside the same region and/or income group. Second, using the global average wage ratio penalizes countries with data where the reported wage ratio is below the global average.

The wage data are only available from 1995-2011. To cover the period 1990-2013 and fill in the series for countries with missing data, we impute the missing data using interpolation for those countries that have a reasonable amount of data (at least 5 years) and for those that do not, we use a regional average in place of the UN's global average ratio.

After the wage interpolation, our data cover 146 countries from 1990-2013. To construct the GDI, TC version, we followed the steps of computing the GDI, as described in the HDR 2014 technical notes.[3] Our calculations vary slightly from the UNDP's because data have been updated since the UNDP's original calculations. Given the problem of missing wage data, we also try substituting the labor force participation rate as an indicator in the "standard of living" sub-index. The most significant deviation from the UNDP's GDI is that the index value for all countries is reduced. In fact, while the UNDP's GDI shows a number of countries with gender disparity in favor of women, we see that all countries now have an index value below one.

[3] HDR technical notes available at http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf

Table D3 provides a correlation matrix using Spearman's rank correlation between the UNDP's GDI; the GDI, TC version, with wages; and the TC version with the labor force participation rate in the standard of living sub-index. It is apparent that while the two ranks are still strongly correlated they do differ slightly.

Table D3: Spearman Rank Correlation Between Different Calculations of the GDI

GDI	Original	TC Version	TC version with LFPR
Original	1		
TC version	0.96***	1	
TC version with LFPR	0.75***	0.81***	1

***, **, and * denote significance at the 1, 5, and 10 percent level
Sources: UNDP Human Development Reports; World Bank; UNESCO; ILO; and IMF staff estimates.

Construction of the GII, TC version

Our data cover 141 countries from 1990-2013. Five indicators are included in our calculation of the GII: maternal mortality ratio, adolescent fertility rate, share of female seats in national parliaments, educational attainment at secondary and tertiary levels, and labor force participation rate.

To have a complete time series we needed to interpolate and extrapolate data for years of missing data. The methods used are as follows. Data for maternal mortality ratio (MMR) are available beginning from 1990 in five-year intervals. Data for in-between years are interpolated using linear interpolation.

Data for adolescent fertility rate are from United Nations Department of Economic and Social Affairs and are available through the World Development Indicators database for most years in our time period (1990-2013). In general, data coverage for this indicator is good with a consistent time series. Countries with missing data tend to be smaller states.

The indicator, female seats in parliament, provided by the Inter-Parliamentary Union , is available beginning in 1990. However, for most countries, data from 1991- mid/late 1990s are missing. Although the gap in data for some countries is large (around eight years), the share of women in parliaments does not change drastically over a short period of time and thus we use linear interpolation to fill in years of missing data.

Educational attainment for the purposes of the GII is defined as attainment at secondary and higher education levels, or as referred to by UNESCO "population over the age of 25 with at least secondary education." To create this variable, we use data from two sources: Barro and Lee (2014) and UNESCO Institute for Statistics.

Using the Barro and Lee data, we add the "percent of secondary schooling attained in population" to the "percent of tertiary schooling attained in population" to estimate the population with at least secondary education. To supplement missing data, we use UNESCO's indicator "population with at least secondary education (+25)." We use linear interpolation when the missing data are between two points of available data. However for recent years where linear interpolation is not possible, we use the most recent year of data as a substitute. For some countries data from as far back as 2010 is used in the calculation of the most recent year of the index.

Finally, data for labor force participation rate are provided by the ILO and are available through the World Bank Indicators database. In general, countries with data have a complete time series from 1990-2013. For countries where data are missing in the most recent years we use the most recent available year of data to fill in the missing data points.

To reconstruct the GII, we followed the steps as described in UNDP's Human Development Report 2014 technical notes.[4] To compare our calculations of the GII to UNDP's calculations we calculated the Spearman's rank correlation, the most recent year of the index. We found that our calculations come very close to the UNDP's calculations with Spearman's rho of 0.99 and significant at the 1 percent level. The slight variation is due to updates in the indicators used.

[4] See http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf.