



# SOCIAL PROGRESS INDEX **2017**

## METHODOLOGY REPORT

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**SOCIAL  
PROGRESS  
IMPERATIVE**

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## INTRODUCTION

Measuring multiple dimensions of social progress is indispensable to understanding its components, benchmarking success, and catalyzing improvement. The Social Progress Index provides a holistic, objective, transparent, outcome-based measure of a country's wellbeing that is independent of economic indicators.

The Social Progress Index catalyzes improvement. It can be used to compare countries on different facets of social progress, allowing the identification of specific areas of strength or weakness at the country level. It also allows countries to benchmark themselves against other countries both at the level of individual indicators as well as in terms of more aggregate measures of social progress.

This report describes the methodology used to calculate the Social Progress Index. We first describe the conceptual architecture of the Index and the distinction between input and outcome indices. We then provide an overview of how we measure social progress, and how we select and refine the data used

to calculate the Social Progress Index. We follow with detailed steps on calculating the Index and assessing countries' strengths and weaknesses. The report concludes with a discussion of the comparability the Social Progress Index across years.

## SOCIAL PROGRESS PRINCIPLES

Guided by a group of academic and policy experts, we have developed a conceptual framework that defines social progress as well as its key elements. We define 'social progress' as *the capacity of a society to meet the basic human needs of its citizens, establish the building blocks that allow citizens and communities to enhance and sustain the quality of their lives, and create the conditions for all individuals to reach their full potential*. This definition of the concept of 'social progress' is used throughout this report. It alludes to three broad elements of social progress, which we refer to as dimensions: Basic Human Needs, Foundations of Wellbeing, and Opportunity. Each of these dimensions is further broken down into four underlying components (see Figure M.1).

Figure M.1 / **Social Progress Index Component-Level Framework**



Together, this set of interrelated factors represents the primary elements that combine to produce a given level of social progress. The Social Progress Index methodology allows measurement of each component and each dimension, and yields an overall score and ranking.

The Social Progress Index is explicitly focused on non-economic aspects of national performance. Unlike most other national measurement efforts, we treat social progress as distinct though associated with traditional economic measures such as GDP per capita. In contrast, other indices such as the Human Development Index or OECD Better Life Index combine economic and social indicators. Our objective is to utilize a clear yet rigorous methodology that isolates the non-economic dimensions of social performance.

Our approach builds on a long line of work constructing country indices to measure and assess various facets of economic and social performance. However, the Social Progress Index is distinct in its core methodological choices:

- A focus on non-economic dimensions of national performance
- A measurement approach based on outcome indicators, rather than input measures
- A holistic framework consisting of three broad dimensions of social progress, each of which is the sum of four equally weighted components
- Calculation of each component as the weighted sum of a series of measures, with the weights determined through principal component analysis

## “Beyond GDP” Measurement

When Simon Kuznets first introduced the modern measure of national Gross Domestic Product (GDP) to the U.S. Congress, he warned of its limitations. The concept of national development is complex, and an economic measure such as GDP cannot on its own provide a measure of quality of life. The Social Progress Index framework was developed to complement and inform GDP. It embodies a large body of research emphasizing the importance of moving “beyond GDP” to truly understand people’s lived experiences.

There are several ways to measure societal wellbeing. In their book *Beyond GDP*, Marc Fleurbaey and Didier Blanchet explain that “beyond GDP” measurements tend to draw from one of four methodological approaches: the subjective approach, which uses measures such as happiness and life satisfaction; composite indices such as the Human Development Index or OECD Better Life Index; dashboards that present unique, non-aggregated indicators; and the accounting and monetary approach that adjusts economic measures for performance on social outcomes. Each of these approaches has particular advantages and disadvantages (and some prior approaches combine these approaches).<sup>1</sup> However, each approach either amends the measurement of GDP itself, includes components additional to GDP, or develops alternative measures (such as subjective wellbeing measures) that reflect both economic and social progress.<sup>2</sup> None distinctly measures social progress on its own.

1. To be clear, there are many individual indices that combine approaches or for which data limitations reduce the consistency of a particular methodology. For example, though Sen’s capabilities perspective offers a compelling focus on the realization of objective dimensions of the human experience, the most well-known measure connected to that approach—the justly influential Human Development Index—is a simple composite index that captures only two concrete dimensions beyond GDP (longevity and education).

2. A complete literature review is beyond the scope of this short note. For an insightful framework and contemporary discussion of both the challenges and progress in moving “beyond GDP,” see Fleurbaey and Blanchet (2013).

The Social Progress Index, in contrast, has been guided since the outset by the objective of developing a practical and usable measure of social progress that is *independent* of GDP. By constructing a separate social progress measure that can stand alongside GDP, policymakers, societal stakeholders, and researchers can develop and implement a systematic and structured approach to inclusive development. Our approach draws on prior research and methods in key ways, including the wide range of academic sources on the challenges and importance of measuring “beyond GDP” as well as more specific insights on how to consider social progress in a comprehensive way. Our background research looks across the fields of economics, sociology, political science, history, and others (key references are included at the end). In addition, we benefited from an interactive process of engagement with academic experts, policymakers, and practitioners from around the world. We differentiate ourselves from earlier efforts not simply by the novelty of our framework, but by our overarching choice to develop a systematic and distinctly non-economic measure of social progress.

### Outcome Indices versus Input Indices

There are two broad categories of conceptually coherent methodologies for index construction: input indices and outcome indices. Both can help countries to benchmark their progress, but in very different ways. Input indices measure a country’s policy choices or investments believed or known to lead to an important outcome, while outcome indices directly measure the outcomes of investments. In competitiveness, for example, an input index might measure investments in human capital or basic research whereas an outcome index might include productivity per working-age citizen.

Whether to utilize an input index or an outcome index depends on the specific problem to be addressed and the data available. On the one hand, a well-constructed, input-driven index can provide direct guidance to policy-makers about specific policy choices and investments. Creating an input index, however, requires a degree of consensus about how inputs lead to outcomes, as well as a process to calibrate the relative importance of different input factors against outcome measures. In the field of social progress, this would mean a clear consensus and understanding of which inputs lead to better social outcomes—a field of research that is still growing and to which the Social Progress Index continues to contribute.

When there are multiple output measures or a lack of consensus on all the inputs that matter, or when data related to inputs are highly incomplete, an outcome-oriented index may be more appropriate (Fleurbaey and Blanchet, 2013). As powerfully articulated by Amartya Sen in his development of the capability approach, a constructive way to move “beyond GDP” is to measure how well a particular society helps individuals realize particular capabilities and activities. Following this logic, the Social Progress Index has been designed as an outcome index. Given that there are many distinct aspects of social progress that are measurable in different ways, the Social Progress Index has been designed to aggregate and synthesize multiple outcome measures in a conceptually consistent and transparent way that will also be salient to benchmarking progress for decision-makers. The Social Progress Imperative continues to explore the role of input measures and policies in determining a country’s performance.

## METHODOLOGY OVERVIEW

The Social Progress Index embodies a large body of research on moving “beyond GDP” that has identified the social and environmental elements of the performance of countries. We have combined the concepts stressed in such research along with moral philosophies dating back to Aristotle to compose the underpinning framework of the Social Progress Index.<sup>3</sup> Specifically, we consider social progress in a systematic and comprehensive way, with a framework that comprises three architectural elements: dimensions, components, and indicators.

- **Dimensions** represent the broad conceptual categories that define social progress. The Index is calculated as the equally-weighted average of a country’s score on each of three dimensions.
- Within each dimension are **components**: four unique but related concepts that together make up each dimension. A country’s dimension score is calculated as the equally-weighted average of the four components in that dimension.
- Each component is composed of **indicators** that measure as many valid aspects of the component as possible. These indicators are aggregated using a weighted average, where the weights are determined by principal component analysis.

## Three Dimensions of the Social Progress Index

At the topmost level of the framework, we have synthesized three distinct though related questions that, taken together, offer insight into the level of social progress:

1. Does a country provide for its people’s most essential needs?
2. Are the building blocks in place for individuals and communities to enhance and sustain wellbeing?
3. Is there opportunity for all individuals to reach their full potential?

These questions describe each of the three dimensions of social progress, respectively: Basic Human Needs, Foundations of Wellbeing, and Opportunity. Under the first dimension, Basic Human Needs, the Social Progress Index assesses citizens’ ability to survive with adequate nourishment and basic medical care, clean water, sanitation, adequate shelter, and personal safety. These needs are still not met in many disparate countries and are often incomplete in more prosperous countries.

While basic needs have been the predominant focus of research in development economics, a second dimension of social progress captures whether a society offers building blocks for citizens to improve their lives. Are citizens able to gain a basic education, obtain information, and access communications to achieve their full potential? Do they benefit from a modern healthcare system and live in a healthy environment that will ensure a prolonged life? Nearly all countries struggle with at least one of these aspects.

Finally, any discussion of social progress must include not only whether citizens are able to improve their own lives, but whether they have the freedom and opportunity to make their own choices. Personal rights, personal freedom and choice, tolerance and inclusion, and

3. For a deeper discussion of the philosophies and principles behind the design of the Social Progress Index, see Chapter 2 of the 2014 Social Progress Index Methodological Report, available on Social Progress Imperative’s website.

access to advanced education all contribute to the level of opportunity within a given society. This dimension of the Social Progress Index is perhaps most controversial and most difficult to measure. Nonetheless, societies struggle to meet the moral imperative to guarantee equality of opportunity for all citizens.

As an empirical matter, we do not judge any one of the dimensions to have an a priori higher weighting than any other, and the Social Progress Index score is a simple average of the three social progress dimensions. In the earliest rendition of the Social Progress Index, we considered other avenues to weighting such as using the coefficients of a regression of life satisfaction scores against the three dimension scores. Though the results were intriguing, we did not believe that they established a sufficiently robust relationship between the dimensions to justify weighting them differently in our calculation of the overall score. We therefore calculate a simple average of the dimensions in order to highlight the critical role of each in social progress.

### Components of Each Dimension

Each of the three dimensions of social progress is composed of four components. Components, like dimensions, are categories of outcomes rather than specific outcomes. Every component within a dimension is designed to highlight a separate aspect of the overall set of outcomes that make up a dimension, building on both the academic and policy literature. For example, the Opportunity dimension includes the components Personal Rights, Personal Freedom and Choice, Tolerance and Inclusion, and Access to Advanced Education. Each of these components describes a related but distinct aspect of what it means for a society to guarantee opportunity among its citizens. The Personal Rights

and Access to Advanced Education components describe different aspects of the extent to which individuals are able to pursue their own objectives to the best of their ability. Personal Freedom and Choice and Tolerance and Inclusion, on the other hand, describe different aspects of the extent of limits on individuals. Together, these four components offer a conceptually coherent way of capturing how societies can empower (or limit) an individual's autonomy, freedom, and ability to progress.

The selection of the dimensions and the elaboration of the components within each dimension occurred through an iterative process involving review of relevant literature and input from the Social Progress Imperative Advisory Board. The components represent what we believe to be the most complete set of broad outcome elements available given our current understanding from diverse literatures.

We have also consulted extensively with experts across disciplines on the twelve-component structure of the Social Progress Index to ensure that it captures the principal aspects of human wellbeing incorporating, but not confined to, challenges such as those affected by extreme poverty. The issues covered in the Social Progress Index are comprehensive and apply to all societies, regardless of their country's level of economic development, political stature, or location in the world.

As in weighting across dimensions, the Social Progress Index architecture equally weights components for constructing a dimension-level score because there is no clear theoretical or empirical reason to weight any of the components more highly than any other. For this reason, each dimension score is composed of the simple average of its underlying four components.

## Measuring Individual Components

At the most granular level of social progress, the Social Progress Index framework identifies multiple independent outcome measures (“indicators”) related to each component. Indicators can be widely diverse and may change with each iteration of the Social Progress Index. However, grouped together by component, they define and measure the same aspect of social progress.

We only include indicators that are measured well, with consistent methodology, by the same organization, and across all (or essentially all) of the countries in our sample. We do not use different sources to report the same outcome indicator across countries. As such, in our overall assessment of indicators each year of Social Progress Index publication, each indicator must meet three criteria:

- **It is internally valid.** We evaluate each indicator to ensure that the procedures used to produce the measure are sound and that it captures what it purports to measure.
- **It is publicly available.** To meet our goals of transparency and independent replication, indicator data must be available to the public. We publish the data for each indicator on our website.
- **Its geographic coverage is extensive.** Each indicator must be available for most, if not all, of the countries in our sample.

In the 2017 Social Progress Index, there are 50 indicators measuring the components of social progress (Figure M.2, next page). These indicators are aggregated to the component level using principal component analysis (PCA) to determine the weight of each measure. We discuss these data and aggregation methodology in greater detail in the next section.

Figure M.2 / The Indicators of the Social Progress Index Framework

Basic Human Needs	Foundations of Wellbeing	Opportunity
<p><b>Nutrition and Basic Medical Care</b></p> <ul style="list-style-type: none"> <li>Undernourishment</li> <li>Depth of food deficit</li> <li>Maternal mortality rate</li> <li>Child mortality rate</li> <li>Deaths from infectious diseases</li> </ul> <p><b>Water and Sanitation</b></p> <ul style="list-style-type: none"> <li>Access to piped water</li> <li>Rural access to improved water source</li> <li>Access to improved sanitation facilities</li> </ul> <p><b>Shelter</b></p> <ul style="list-style-type: none"> <li>Availability of affordable housing</li> <li>Access to electricity</li> <li>Quality of electricity supply</li> <li>Household air pollution attributable deaths</li> </ul> <p><b>Personal Safety</b></p> <ul style="list-style-type: none"> <li>Homicide rate</li> <li>Level of violent crime</li> <li>Perceived criminality</li> <li>Political terror</li> <li>Traffic deaths</li> </ul>	<p><b>Access to Basic Knowledge</b></p> <ul style="list-style-type: none"> <li>Adult literacy rate</li> <li>Primary school enrollment</li> <li>Secondary school enrollment</li> <li>Gender parity in secondary enrollment</li> </ul> <p><b>Access to Information and Communications</b></p> <ul style="list-style-type: none"> <li>Mobile telephone subscriptions</li> <li>Internet users</li> <li>Press Freedom Index</li> </ul> <p><b>Health and Wellness</b></p> <ul style="list-style-type: none"> <li>Life expectancy at 60</li> <li>Premature deaths from non-communicable diseases</li> <li>Suicide rate</li> </ul> <p><b>Environmental Quality</b></p> <ul style="list-style-type: none"> <li>Outdoor air pollution attributable deaths</li> <li>Wastewater treatment</li> <li>Biodiversity and habitat</li> <li>Greenhouse gas emissions</li> </ul>	<p><b>Personal Rights</b></p> <ul style="list-style-type: none"> <li>Political rights</li> <li>Freedom of expression</li> <li>Freedom of assembly</li> <li>Private property rights</li> </ul> <p><b>Personal Freedom and Choice</b></p> <ul style="list-style-type: none"> <li>Freedom over life choices</li> <li>Freedom of religion</li> <li>Early marriage</li> <li>Satisfied demand for contraception</li> <li>Corruption</li> </ul> <p><b>Tolerance and Inclusion</b></p> <ul style="list-style-type: none"> <li>Tolerance for immigrants</li> <li>Tolerance for homosexuals</li> <li>Discrimination and violence against minorities</li> <li>Religious tolerance</li> <li>Community safety net</li> </ul> <p><b>Access to Advanced Education</b></p> <ul style="list-style-type: none"> <li>Years of tertiary schooling</li> <li>Women's average years in school</li> <li>Inequality in the attainment of education</li> <li>Globally ranked universities</li> <li>Percentage of tertiary students enrolled in globally ranked universities</li> </ul>

## DATA

### Indicator Sources and Selection

The Social Progress Index is an aggregate measure derived from numerous indicators drawn from many different organizations. Data sources range from very large institutions like the United Nations, to non-governmental organizations such as Transparency International. They also include data collected via global surveys, such as Gallup's World Poll. The sources are summarized in Appendix 1. For each indicator, we evaluate the data sources available and consider the tradeoffs between the quality and precision of a social indicator and its broad coverage of countries and continents. The architecture of the Index affects the screening criteria for data sources.

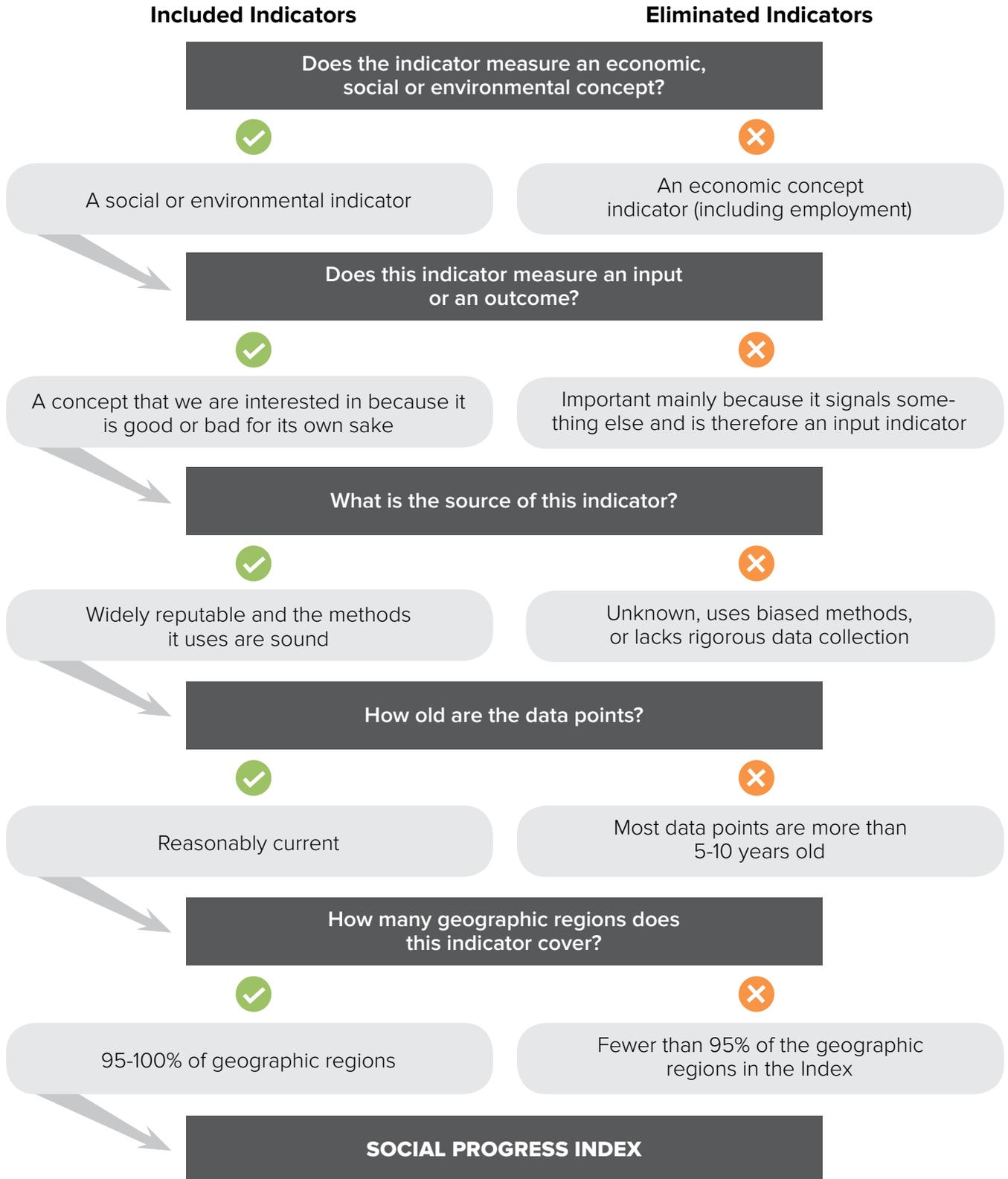
Similar to the state of affairs in the mid-20th century for measuring economic variables, social scientists have only just begun to build the complicated infrastructure required to successfully mount the large-scale surveys and measurements required to provide effective measurements of social issues across countries. Not surprisingly, the UN and its various entities have taken the lead, and we include UN data ranging from the percent of a population with access to piped water drawn from the Joint Monitoring Programme for Water Supply and Sanitation, to the percentage of children enrolled in primary education from the UN Educational, Scientific, and Cultural Organization Institute for Statistics. For other metrics, we rely on specialist organizations such as the Institute for Economics and Peace, which supplies personal safety data. One of our objectives is to stimulate improvement in data sources over time.

In an effort to measure solely outcomes, not inputs, we have focused on results that matter to the lives of real people, not whether certain things are legally permissible or how much money the government spends. In some cases, this requires survey data. For example, same-sex sexual activity has been legal in Moldova since 1995, but according to the Gallup World Poll, only 3.5 percent of the population replied yes to a question on whether Moldova is a good place for homosexuals. Due to divergences like this, we concluded that sometimes survey data, as a representation of people's lived experiences, is the better outcome measure.

For some indicators, such as corruption, there were alternative data sources that provided similar indicators. We evaluated alternatives based on internal validity, geographic coverage, and theoretical attractiveness (what methodology was used to gather data). Geographic coverage was often a key limitation. We sought indicators that were measured by the same organization for all the countries in our initial sample. This meant that many high-quality indicators were excluded from consideration because they only covered a subset of countries (e.g., just Latin America or just OECD countries). The step-by-step process for selecting indicators is outlined in Figure M.3 (next page).

There are additional indicators we hope to use in the future, but which are not yet measured broadly or in a standard way. For instance, in the Access to Basic Knowledge component one could imagine a number of interesting indicators like the Program for International Student Assessment (PISA) scores to measure educational attainment rather than enrollment. While there is PISA data for a number of countries, the scores do not cover a broad enough country sample for inclusion in the Index.

Figure M.3 / Indicator Selection Decision Tree



## Indicator Transformations

In comparing country-level data, we encounter issues that require us to transform the data for certain indicators. Most indicator data in raw form range from 0–100 or from 1–5. Such indicators are constructed to have clear upper and lower bounds. However, there are cases in which data values exceed a rational boundary or are far beyond the mean value for an indicator and excessively skew results. In such cases, we either confine the indicator to a rational boundary, or we transform the continuous data of an indicator into an ordinal scale.

- Confined indicators:** We impose a lower boundary on one indicator and upper boundaries on four indicators to correct for outlying data values (Figure M.4). Data for depth of food deficit, collected by the World Health Organization, are generally confined to a depth of eight calories or more in standard measurement. Six countries register depth of food deficit of fewer than eight calories. To ensure these countries do not have an advantage in performance solely due to differences in measurement, we assign each of these six countries a value of 8. In the Access to Basic Knowledge component, we cap secondary school enrollment at 100% since UNESCO’s calculation of the gross enrollment ratios for secondary school includes both over- and under-age children, which can result in a ratio of over 100%. We also cap literacy rate at 99% due to lack of confidence in the significant digits in the data used for developed countries. Mobile telephone subscriptions is capped at 100 subscriptions to reflect the boundary set by its unit of measurement (number of subscriptions per 100 people), and greenhouse gas emissions is capped at 1,500 CO<sub>2</sub> equivalents per GDP-PPP to treat outlier values of six countries that otherwise positively skew the data.

Figure M.4 / **Confined Indicators**

INDICATORS	MIN	MAX
Depth of food deficit	8	N/A
Secondary school enrollment	0	100
Adult literacy rate	0	99
Mobile telephone subscriptions	0	100
Greenhouse gas emissions	0	1,500

- Transformed ordinal indicators:** We transform two indicators within Access to Advanced Education into ordinal measures to more distinctly capture data variation along the distribution. For both globally ranked universities and percent of tertiary students enrolled in globally ranked universities, the amount of variation in country performance differs in magnitude at the bottom of the distribution than at the top. Many countries have between one and ten globally ranked universities, whereas the gap in number of universities between those with more than ten universities are much larger. (United States, for example, has 199 globally ranked universities, compared to second-ranked United Kingdom’s 92.) The two transformed indicators are listed below, with full definitions of the ordinal values in the appendix of our 2017 Social Progress Index report.

Figure M.5 / **Indicators Transformed into Ordinal Variables**

INDICATORS	MIN	MAX
Globally ranked universities	0	10
Percent of tertiary students enrolled in globally ranked universities	0	6

In addition to these transformed ordinal variables, there are seven other indicators that are measured as integers on a condensed scale. These include: level of violent crime (min=5, max=1); perceived criminality (min=5, max=1); political terror (min=5, max=1); political rights (min=0, max=40); freedom of expression (min=0, max=16); freedom of religion (min=1, max=4); and religious tolerance (min=1, max=4).

● **Inverted indicators:** We invert some indicators so that a higher value reflects better social progress. In all, there are 20 indicators that we invert before final calculation of the Index. These include (by component):

- Undernourishment, depth of food deficit, maternal mortality rate, child mortality rate, and deaths from infectious diseases (*Nutrition and Basic Medical Care*)
- Household air pollution attributable deaths (*Shelter*)
- Homicide rate, level of violent crime, perceived criminality, political terror, and traffic deaths (*Personal Safety*)
- Gender parity in secondary enrollment (*Access to Basic Education*)
- Press Freedom Index (*Access to Information and Communications*)
- Deaths from non-communicable diseases and suicide rate (*Health and Wellness*)
- Outdoor air pollution attributable deaths and greenhouse gas emissions (*Environmental Quality*)
- Early marriage (*Personal Freedom and Choice*)
- Discrimination and violence against minorities (*Tolerance and Inclusion*)
- Inequality in the attainment of education (*Access to Advanced Education*)

All transformations are applied to data after estimating missing values, a process discussed later in this report.

## Evaluating the Fit between Indicators

The Social Progress Index includes the best available and valid indicators that are conceptually linked to the components. We ensure the rigor of our methodology by assessing multiple aspects of fit between indicators in the Social Progress Index. First, we rely upon exploratory factor analysis to draw out the common signal among the set of selected indicators in each component. In this process, we test new candidate indicators and remove those that are both conceptually and statistically incompatible.

In most cases, there is conceptual overlap among the measures that are included to capture various aspects of the same component. For instance, in Nutrition and Basic Medical Care, two distinct but closely related measures are included: undernourishment and depth of food deficit. To account for the strong correlative relationship between these elements, we use principal component analysis (PCA) to calculate the final score, discussed further in section 5.1.

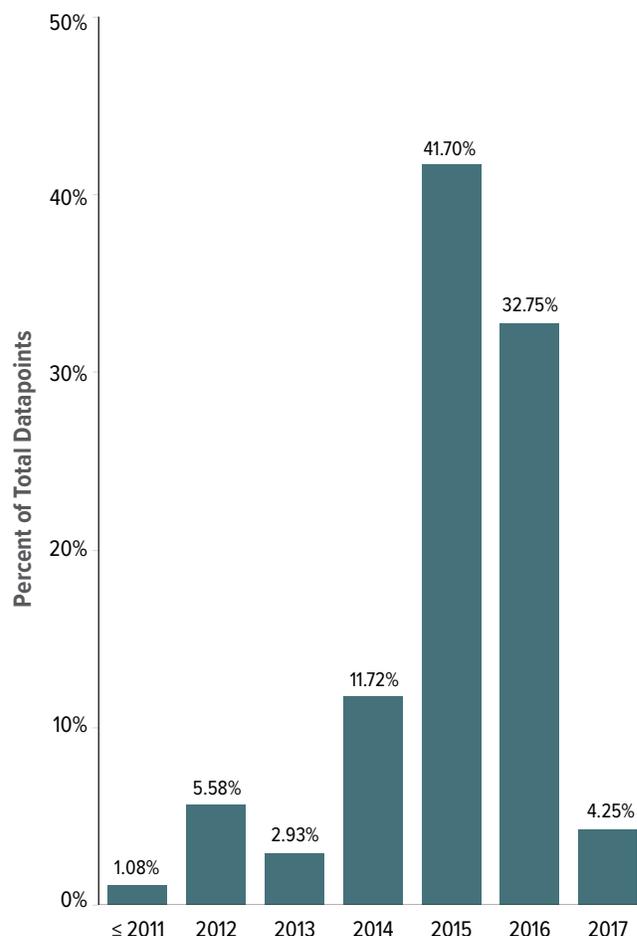
In addition, we evaluate the fit between the individual indicators by calculating Cronbach's alpha for each component.<sup>4</sup> Cronbach's alpha provides a measure of internal consistency across indicators. An applied practitioner's rule of thumb is that the alpha value should be above 0.7 for any valid grouping of variables (Bland and Altman, 1997). Figure M.6 shows standardized alpha values well above 0.7 for most components, with few close to the threshold. Cronbach's alpha is a good preliminary screen for conceptual fit; it does not provide a direct measure of the goodness of fit of a factor analysis (Manly, 2004).

4. In these assessments, we use all Social Progress Index historical data at once to increase the reliability of our tests. In 2017, we combined the 2017 Social Progress Index data with data to calculate Social Progress Indexes for the years 2014, 2015, and 2016.

Figure M.6 / Cronbach’s Alpha for Each Component

	Component	Cronbach’s Alpha
Basic Human Needs	Nutrition and Basic Medical Care	0.92
	Water and Sanitation	0.93
	Shelter	0.80
	Personal Safety	0.81
Foundations of Wellbeing	Access to Basic Knowledge	0.88
	Access to Information and Communications	0.68
	Health and Wellness	0.71
	Environmental Quality	0.73
Opportunity	Personal Rights	0.93
	Personal Freedom and Choice	0.70
	Tolerance and Inclusion	0.75
	Access to Advanced Education	0.90

Figure M.7 / Percentage of Data Points Published in Each Year



### Characteristics of Country Data

The use of data in the 2017 Social Progress Index is limited to 2006–2016 data for any given indicator and country. This is done to create the most current index possible while not excluding indicators or countries that update on a less frequent basis. The average year of data in the 2017 Social Progress Index is 2015. Only one percent of data points are from 2011 or earlier. Figure M.7 shows the percentage of data points from each year across all countries with sufficient data to calculate at least nine complete components.

## Sub-National Differences

The nature of a global index is to measure how countries at the national level perform on a certain set of indicators. An important tool, the Social Progress Index is useful for comparing countries to one another and assessing both absolute level of progress and relative performance to find best practices and target areas which need improvement or from which other countries can learn. The Index provides a view into how a country performs on average, informing the many policies and investments that affect social progress at the national level. However, aggregate data can obscure substantial regional and state differences in performance that are equally important to a country's policy considerations, especially in geographically large nations. We have learned from work at the sub-national level that the Social Progress Index framework can be applied locally within countries, producing informative results that can drive action. For example, in 2016 the European Union Regional Social Progress Index assessed social progress levels within 272 NUTS 2 regions of the EU28, finding large disparities and varying priorities among the regions.<sup>5</sup> While the global Social Progress Index is a great starting point for targeting successes and challenges, continued research and indexing at the sub-national level will add greater clarity. We have several initiatives underway at city and region levels, discussed in the final section of the Social Progress Index 2017 report.

## Estimates for Missing Values

We have carefully selected our country set for 2017 to have the most coverage possible across all indicators, without jeopardizing the statistical quality of the Index. The countries for which we calculate a Social Progress Index score have no more than one missing value in fewer than three components. Missing values can stem from lack of coverage by the data source, incomplete reporting by the country to international organizations, or outdated data.<sup>6</sup> If a country is missing data for only one indicator within a component, we estimate its value using a regression process applied at the component level. In other words, we use our country sample data<sup>7</sup> to regress each indicator on the other indicators within a component to predict missing values. Constraining the regression to within-component indicators allows for the preservation of the signal that the indicator provides to PCA.

In exceptional situations where estimated values substantially exceed rational boundaries or where values are missing for a specific group of countries (for example, tolerance for homosexuals in the Middle East), we apply qualitative and cohort group estimates.

The estimation of missing values is necessary prior to undertaking PCA, which requires a complete dataset for the results to be sound.

5. More information is provided at [http://ec.europa.eu/regional\\_policy/en/information/maps/social\\_progress](http://ec.europa.eu/regional_policy/en/information/maps/social_progress)

6. We assess the historical data available for each country and typically treat data as missing if the most recent data point is older than ten years from the Social Progress Index publication year. For survey data, we limit the most recent data point to five years. In some cases where a regression estimation is drastically different than the trends suggested by historical data, we will use slightly older data, though none dating back farther than 2005.

7. These data include data to for calculating Social Progress Index 2014, 2015, and 2016 to increase the reliability of estimates.

## CALCULATING THE SOCIAL PROGRESS INDEX

### Indicator Weights and Aggregation

We use principal component analysis (PCA) to determine the weighting of each indicator within a component. This technique combines indicators into a component that captures the maximum amount of variance in the data while reducing any redundancy between indicators. In researching the best construction for the Social Progress Index, we pursued both an equal weighting of indicators within each component and the use of PCA to calculate weights for each indicator. Through this process, we found that PCA weighted indicators very near to equally within many components, signaling a good selection of indicators to measure the concept of the component (for analysis of change in overall Social Progress Index rank using equal weighting, see Appendix D). There are some components that are more challenging to measure due to the restricted measurement scales of some indicators and their divergent behavior with other indicators within a component. For example, some countries may have strong performance on globally ranked universities and percentage of tertiary students enrolled in globally ranked universities, but weak performance on women’s mean years in school. In such cases, PCA is an especially important methodology, weighting indicators appropriately to reach the best composite measure of each component.

Our choice of PCA as the basis for aggregation at the component level was also influenced by the quality and quantity of data available on social progress. For PCA to be valid, each indicator must be relatively free of measurement error (Dunteman, 1989). Thus, it should precisely measure what it was intended to measure and do so consistently across countries. Our design principles and the data we use fulfill this requirement.

After performing PCA in each component, we assess goodness of fit using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The results of this analysis are shown in Figure M.8. In general, KMO scores should be above 0.5. In our data, the mean KMO score is above 0.5 for all components, showing that the grouping of indicators chosen for the components of the Social Progress Index provides a good measure of the underlying construct.

Figure M.8 / Mean Kaiser-Meyer-Olkin Measure of Sampling Adequacy for Each Component

	Component	Mean KMO
Basic Human Needs	Nutrition and Basic Medical Care	0.75
	Water and Sanitation	0.75
	Shelter	0.68
	Personal Safety	0.77
Foundations of Wellbeing	Access to Basic Knowledge	0.80
	Access to Information and Communications	0.60
	Health and Wellness	0.50
	Environmental Quality	0.73
Opportunity	Personal Rights	0.80
	Personal Freedom and Choice	0.68
	Tolerance and Inclusion	0.69
	Access to Advanced Education	0.76

The individual component values are calculated by summing the weighted scores to reach the component, as noted in the formula below:

Formula 1  $Component_c = \sum_i (w_i * indicator_i)$

The weights ( $w$  in the equation) are determined through PCA. See Appendix B for a full list of weights and the corresponding values on a 0 to 1 scale for ease of interpretation.

## Component Scores

The final step in calculating each component is to provide transparency and comparability across the different components. Our goal is to transform the values so that each component score can be easily interpreted, both relative to other components and across different countries. To do so, we calculate scores using an estimated best- and worst-case scenario dataset in addition to the individual country data. The best- and worst-case scores are defined at the indicator level according to the definition of each data point. For indicators that do not have a clear best or worst bound or where the probability of reaching a bound is extremely unlikely (e.g., child mortality, where the theoretical worst case would be that every child dies before the age of five), we use a bound based on the worst-recorded performance

since 2004 across all years and countries available in the indicator dataset as available from the source, not just from our sample of countries. Best- and worst-case data series are included with the country set when PCA is applied. See Appendix C for the specific values used for each indicator's bounds.

This process allows for countries to be scored on a 0 to 100 scale with 100 being the estimated best case and 0 signifying the estimated worst case at the component level. The following formula is used to calculate a component score for each country:

$$\text{Formula 2} \quad \frac{(X_j - \text{Worst Case})}{(\text{Best Case} - \text{Worst Case})}$$

where X is the raw component value for each country. The summary statistics after this final transformation of the data are provided in Figure M.9.

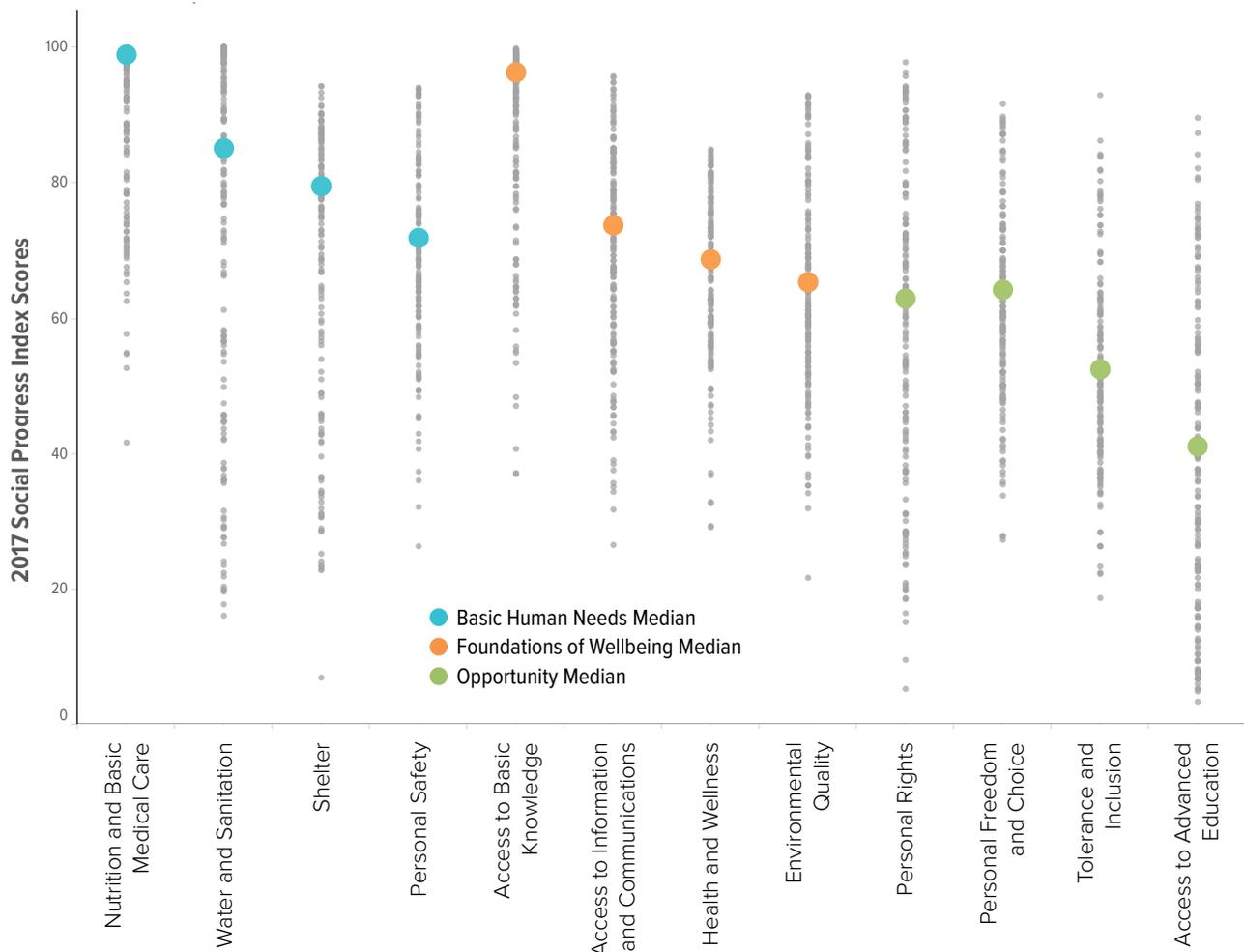
Figure M.9 / Summary Statistics for Each Component by Dimension across All Countries in the 2017 Social Progress Index

	Component	Mean	Standard Deviation	Min	Max
Basic Human Needs	Nutrition and Basic Medical Care	88.98	12.61	41.62	99.65
	Water and Sanitation	73.12	26.32	16.03	100.00
	Shelter	67.59	20.88	6.96	94.28
	Personal Safety	69.34	14.58	26.39	94.02
Foundations of Wellbeing	Access to Basic Knowledge	85.86	14.87	37.03	99.86
	Access to Information and Communications	69.30	15.57	26.58	95.80
	Health and Wellness	65.35	12.40	29.03	84.92
	Environmental Quality	64.39	15.42	21.64	92.99
Opportunity	Personal Rights	58.26	23.43	5.31	97.89
	Personal Freedom and Choice	62.00	14.47	27.26	91.69
	Tolerance and Inclusion	52.22	15.16	18.75	93.04
	Access to Advanced Education	40.11	23.03	3.45	89.55

There are differences across the components in terms of their overall score variation, which are displayed in Figure M.10. For example, some components have a high overall range (such as Water and Sanitation), because some countries score perfectly with no need for improvement, while other countries struggle to

meet these infrastructure needs. Other components, such as Health and Wellness, have a much smaller range, due in part to the great strides the world has made in health since 2004. Even for this component, however, there is much room for improvement.

Figure M.10 / **Distribution of Component Scores**



## Dimension Scores

Figure M.11 provides summary statistics for each dimension, where each dimension score is the average of the four components that make up that dimension (see Formula 3 below). Countries that do not have scores in all four components of a given dimension will not have a dimension score.

$$\text{Formula 3} \quad \text{Dimension}_d = \frac{1}{4} \sum_c \text{Component}_c$$

## Index Scores

The overall Social Progress Index is calculated as the simple average of the three dimensions. As such, a country's Social Progress Index score is calculated as:

$$\text{Formula 4} \quad \text{SPI} = \frac{1}{3} \sum_d \text{Dimension}_d$$

In the 2017 Social Progress Index, scores range from 28.38 to 90.57. It is expected that the range of scores decreases when averaging scores first into dimensions and then into an index. Countries that do not have scores in all three dimensions will not be included in the overall Index scores and ranks.

Figure M.11 / Summary Statistics for Each Dimension

Dimension	Mean	Standard Deviation	Min	Max
Basic Human Needs	74.72	16.90	27.82	96.79
Foundations of Wellbeing	71.34	12.90	35.41	91.75
Opportunity	53.88	16.22	21.90	88.00

## ASSESSING COUNTRIES' RELATIVE STRENGTHS AND WEAKNESSES

The component, dimension, and overall Social Progress Index scores are scaled from 0 to 100 with 100 as the score that a country would achieve were it to have the highest possible score on every indicator, and 0 as the score were it to have the lowest possible score on every indicator. Best and worst are determined as described in Section 5.2. With this scale, it is possible to evaluate a country's performance relative to the best and worst possible score.

In some cases, it is also helpful to compare a country's performance to other countries at a similar level of economic development. For example, a lower-income country may have a low score on a certain component, but could greatly exceed typical scores for countries with similar per capita incomes. Conversely, a high-income country may have a high absolute score on a component, but still fall short of what is typical for comparably wealthy countries. For this reason, we have developed a methodology to present a country's strengths and weaknesses on a relative rather than absolute basis, comparing a country's performance to that of its economic peers. Within the group of peer countries, yellow signifies that a country's performance is typical for countries at its level of economic development ('neutral performance'), blue signifies that the country performs substantially better than its peer group ('over performance'), and red signifies that the country performs substantially worse than its peer group ('under performance').

Standard groupings of countries, such as the income classifications done by the World Bank, are not appropriate for relative comparison of countries for two reasons. First, the groupings are too large, representing excessively wide ranges of social performance and therefore few relative strengths and weaknesses. Second, using these groups,

countries at the top or bottom of a group may appear to have a misleadingly large number of strengths or weaknesses simply because the group the country is being compared to is at a much lower or higher level of economic development. We therefore define the group of a country's economic peers as the 15 countries closest in GDP PPP per capita. Each country's GDP per capita is compared to every other country for which there is full Index data, and the 15 countries with the smallest difference on an absolute value basis are selected for the comparator group. We have found that groupings larger than 15 resulted in a wider range of typical scores and showed too few relative strengths and weaknesses; smaller groupings become too sensitive to outliers. Additionally, to reduce the influence of year-to-year fluctuations in GDP data, we use a four-year average (2012–2015).

We define comparator groups for all countries, regardless of whether they have complete Social Progress Index data or sufficient data for only some indicators, components, and dimensions. However, to maintain stability in comparisons, only countries with full data across all components of the Index are included in comparator groups for other countries. We do not calculate strengths and weaknesses calculations for Libya, due to missing GDP data. Once the group of comparator countries is established, the country's performance is compared to the median performance of countries in the group. The median is used rather than the mean to minimize the influence of outliers. If the country's score is greater than (or less than) the average absolute deviation from the median of the comparator group, it is considered a strength (or weakness). Scores that are within one average absolute deviation are within the range of expected scores and are considered neither strengths nor weaknesses. A floor is established so the thresholds are no less than those for poorer countries and the minimum distance from median to strength or median to weakness is 1 point.

## YEAR-TO-YEAR RESULTS COMPARISON

In the 2017 Index we have made improvements to the way some components are measured through changes to select indicators, as described below. Many data sources also have retroactively revised previously published data, which affects the comparability of one year's published Social Progress Index to the next. To facilitate comparability between the 2014, 2015, 2016 and 2017 Social Progress Indexes, we have recalculated the 2014, 2015, and 2016 Indexes using the updated 2017 methodology and indicators. Doing so provides a four-point time series for the Index, though it is important to note that some indicator data are not collected on an annual basis.

### Changes by Component

The underlying framework of 12 components across three dimensions of social progress remains unchanged from 2016. We note below changes made at the indicator level, either in methodology or in the data published by the source.

**Nutrition and Basic Medical Care:** We changed the source of deaths from infectious diseases from World Health Organization to the Institute for Health Metrics and Evaluation because the data are more recent and are updated more frequently.

**Shelter:** Household air pollution attributable deaths data were retroactively revised.

**Personal Safety:** Data for homicide rate, level of violent crime, perceived criminality, and political terror were retroactively revised.

**Access to Basic Knowledge:** We replaced primary school enrollment to measure total net enrollment rather than gross enrollment so as to capture enrollment of all primary school-aged children, regardless of the level of school in which they are

enrolled (such as pre-primary). We also replaced lower- and upper-secondary school enrollment with one overall measure, secondary school enrollment, as a better comparison of enrollment across different educational systems. Adult literacy rate and gender parity in secondary enrollment data were retroactively revised.

**Access to Information and Communications:** Two of the three indicators within this component have been retroactively revised by their sources: mobile telephone subscriptions and internet users.

**Health and Wellness:** We removed one indicator, obesity rate, because it does not correlate strongly with other indicators within the component. We changed the source of premature deaths from noncommunicable diseases from World Health Organization to the Institute for Health Metrics and Evaluation because the data are more recent and are updated more frequently. Life expectancy at 60 and suicide rate data were retroactively revised.

**Environmental Quality:** Outdoor air pollution attributable deaths data were retroactively revised.

**Personal Rights:** We removed freedom of speech, freedom of assembly/association, and freedom of movement since the Cingranelli-Richards Human Rights Data Project was discontinued. In their place, we added freedom of expression from Freedom House and freedom of assembly from the World Justice Project's Rule of Law Index. Political rights data were retroactively revised.

**Personal Freedom and Choice:** Satisfied demand for contraception data were retroactively revised.

**Access to Advanced Education:** Percentage of tertiary students enrolled in globally ranked universities data were retroactively revised.

## CONCLUSION

The Social Progress Index provides a benchmark by which countries can compare themselves to others, and can identify specific areas of current strength or weakness. Additionally, scoring on a 0–100 scale gives countries a realistic benchmark rather than an abstract measure. This scale allows us to track absolute, not just relative, performance of countries over time on each component, dimension, and the overall model.

The 2017 Social Progress Index results, found in the main report, are a starting point for many different

avenues of research into the ways a country is successful or not and whether conclusions can be drawn about the overall effect of social progress on economic growth. Furthermore, while disaggregated scores provide insight into the behavior of the different components that contribute to a country's performance, we believe disaggregation within a country (e.g. regional or state) also provides important insight and actionable information to those seeking to increase social progress. We continue to test our process and methodology at the regional and city level, replicating the steps outlined in this report to produce meaningful results in different areas of the world.

## APPENDIX A. DATA SOURCES

Component	Indicator Name	Primary Source
<b>Basic Human Needs</b>		
Nutrition and Basic Medical Care	Undernourishment	Food and Agriculture Organization of the United Nations
	Depth of food deficit	Food and Agriculture Organization of the United Nations
	Maternal mortality rate	World Health Organization
	Child mortality rate	UN Inter-agency Group for Child Mortality Estimation
	Deaths from infectious diseases	Institute for Health Metrics and Evaluation
Water and Sanitation	Access to piped water	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
	Rural access to improved water source	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
	Access to improved sanitation facilities	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
Shelter	Availability of affordable of housing	Gallup World Poll
	Access to electricity	Sustainable Energy for All
	Quality of electricity	World Economic Forum Global Competitiveness Report
	Household air pollution attributable deaths	Institute for Health Metrics and Evaluation
Personal Safety	Homicide rate	UN Office on Drugs and Crime
	Level of violent crime	Institute for Economics and Peace Global Peace Index
	Perceived criminality	Institute for Economics and Peace Global Peace Index
	Political terror scale	Institute for Economics and Peace Global Peace Index
	Traffic deaths	World Health Organization

APPENDIX A. DATA SOURCES *(continued)*

Component	Indicator Name	Primary Source
<b>Foundations of Wellbeing</b>		
Access to Basic Knowledge	Adult literacy rate	UN Educational, Scientific, and Cultural Organization
	Primary school enrollment	UN Educational, Scientific, and Cultural Organization
	Secondary school enrollment	UN Educational, Scientific, and Cultural Organization
	Gender parity in secondary enrollment	UN Educational, Scientific, and Cultural Organization
Access to Information and Communications	Mobile telephone subscriptions	International Telecommunications Union
	Internet users	International Telecommunications Union
	Press Freedom Index	Reporters Without Borders
Health and Wellness	Life expectancy at 60	World Health Organization
	Premature deaths from non-communicable diseases	Institute for Health Metrics and Evaluation
	Suicide rate	Institute for Health Metrics and Evaluation
Environmental Quality	Outdoor air pollution attributable deaths	Institute for Health Metrics and Evaluation
	Wastewater treatment	Yale Center for Environmental Law & Policy and Columbia University Center for International Earth Science Information Network Environmental Performance Index
	Greenhouse gas emissions	World Resources Institute
	Biodiversity and habitat	Yale Center for Environmental Law & Policy and Columbia University Center for International Earth Science Information Network Environmental Performance Index

## APPENDIX A. DATA SOURCES (continued)

Component	Indicator Name	Primary Source
<b>Opportunity</b>		
Personal Rights	Political rights	Freedom House
	Freedom of expression	Freedom House
	Freedom of assembly	World Justice Project Rule of Law Index
	Private property rights	Heritage Foundation
Personal Freedom and Choice	Freedom over life choices	Gallup World Poll
	Freedom of religion	Pew Research Center Government Restrictions Index
	Early marriage	OECD Gender, Institutions and Development Database
	Satisfied demand for contraception	United Nations Population Division
	Corruption	Transparency International
Tolerance and Inclusion	Tolerance for immigrants	Gallup World Poll
	Tolerance for homosexuals	Gallup World Poll
	Discrimination and violence against minorities	Fund for Peace Fragile States Index
	Religious tolerance	Pew Research Center Social Hostilities Index
	Community safety net	Gallup World Poll
Access to Advanced Education	Years of tertiary schooling	Barro-Lee Educational Attainment Dataset
	Women's mean years in school	Institute for Health Metrics and Evaluation
	Inequality in attainment of education	United Nations Development Programme
	Number of globally ranked universities	Times Higher Education, QS World University Rankings, and Academic Ranking of World Universities; SPI calculations
	Percent of tertiary students enrolled in globally ranked universities	UNESCO; Times Higher Education World University Rankings, QS World University Rankings, and Academic Ranking of World Universities; SPI calculations

## APPENDIX B. PRINCIPAL COMPONENT ANALYSIS WEIGHTS

Component	Indicator Name	Weight	Scaled Weight
<b>Basic Human Needs</b>			
Nutrition and Basic Medical Care	Undernourishment	0.23	0.20
	Depth of food deficit	0.23	0.20
	Maternal mortality rate	0.23	0.20
	Child mortality rate	0.23	0.20
	Deaths from infectious diseases	0.23	0.20
Water and Sanitation	Access to piped water	0.36	0.34
	Rural access to improved water source	0.35	0.33
	Access to improved sanitation facilities	0.36	0.34
Shelter	Availability of affordable of housing	0.13	0.11
	Access to electricity	0.35	0.30
	Quality of electricity	0.33	0.29
	Household air pollution attributable deaths	0.35	0.30
Personal Safety	Homicide rate	0.21	0.16
	Level of violent crime	0.30	0.23
	Perceived criminality	0.29	0.22
	Political terror scale	0.27	0.20
	Traffic deaths	0.23	0.18

APPENDIX B. PRINCIPAL COMPONENT ANALYSIS WEIGHTS (*continued*)

Component	Indicator Name	Weight	Scaled Weight
<b>Foundations of Wellbeing</b>			
Access to Basic Knowledge	Adult literacy rate	0.31	0.27
	Primary school enrollment	0.28	0.24
	Secondary school enrollment	0.31	0.27
	Gender parity in secondary enrollment	0.26	0.22
Access to Information and Communications	Mobile telephone subscriptions	0.44	0.35
	Internet users	0.47	0.37
	Press Freedom Index	0.36	0.28
Health and Wellness	Life expectancy at 60	0.43	0.35
	Premature deaths from non-communicable diseases	0.48	0.39
	Suicide rate	0.31	0.26
Environmental Quality	Outdoor air pollution attributable deaths	0.38	0.28
	Wastewater treatment	0.36	0.27
	Greenhouse gas emissions	0.26	0.20
	Biodiversity and habitat	0.33	0.25

APPENDIX B. PRINCIPAL COMPONENT ANALYSIS WEIGHTS (*continued*)

Component	Indicator Name	Weight	Scaled Weight
<b>Opportunity</b>			
Personal Rights	Political rights	0.29	0.26
	Freedom of expression	0.28	0.26
	Freedom of assembly	0.28	0.26
	Private property rights	0.23	0.22
Personal Freedom and Choice	Freedom over life choices	0.29	0.22
	Freedom of religion	0.08	0.06
	Early marriage	0.30	0.22
	Satisfied demand for contraception	0.32	0.24
	Corruption	0.35	0.26
Tolerance and Inclusion	Tolerance for immigrants	0.26	0.18
	Tolerance for homosexuals	0.32	0.23
	Discrimination and violence against minorities	0.32	0.23
	Religious tolerance	0.22	0.16
	Community safety net	0.27	0.19
Access to Advanced Education	Years of tertiary schooling	0.26	0.18
	Women's mean years in school	0.32	0.23
	Inequality in the attainment of education	0.32	0.23
	Number of globally ranked universities	0.22	0.16
	Percent of tertiary students enrolled in globally ranked universities	0.27	0.19

## APPENDIX C. BEST AND WORST CASE INDICATOR VALUES

Component	Indicator Name	Best Case	Worst Case
<b>Basic Human Needs</b>			
Nutrition and Basic Medical Care	Undernourishment	5	57.70
	Depth of food deficit	8	586
	Maternal mortality rate	0	2,112.69
	Child mortality rate	0	210.8
	Deaths from infectious diseases	0	1,665.49
Water and Sanitation	Access to piped water	100	0
	Rural access to improved water source	100	8.79
	Access to improved sanitation facilities	100	6.63
Shelter	Availability of affordable of housing	1	0.12
	Access to electricity	100	0
	Quality of electricity	7	1
	Household air pollution attributable deaths	0	322.27
Personal Safety	Homicide rate	0	93.2
	Level of violent crime	1	5
	Perceived criminality	1	5
	Political terror scale	1	5
	Traffic deaths	0	73.40

APPENDIX C. BEST AND WORST CASE INDICATOR VALUES *(continued)*

Component	Indicator Name	Best Case	Worst Case
<b>Foundations of Wellbeing</b>			
Access to Basic Knowledge	Adult literacy rate	99	15.46
	Primary school enrollment	100	30.26
	Secondary school enrollment	100	7.35
	Gender parity in secondary enrollment	0	0.79
Access to Information and Communications	Mobile telephone subscriptions	100	0
	Internet users	100	0
	Press Freedom Index	0	100
Health and Wellness	Life expectancy at 60	28.25	10.26
	Premature deaths from non-communicable diseases	0	1,599.8
	Suicide rate	0	36.20
Environmental Quality	Outdoor air pollution attributable deaths	0	249.26
	Wastewater treatment	100	0
	Greenhouse gas emissions	0	1,500
	Biodiversity and habitat	100	0

APPENDIX C. BEST AND WORST CASE INDICATOR VALUES (*continued*)

Component	Indicator Name	Best Case	Worst Case
<b>Opportunity</b>			
Personal Rights	Political rights	40	0
	Freedom of expression	16	0
	Freedom of assembly	1	0
	Private property rights	100	0
Personal Freedom and Choice	Freedom over life choices	1	0.24
	Freedom of religion	4	1
	Early marriage	0	0.62
	Satisfied demand for contraception	100	0
	Corruption	100	0
Tolerance and Inclusion	Tolerance for immigrants	1	0.09
	Tolerance for homosexuals	1	0
	Discrimination and violence against minorities	1	10
	Religious tolerance	4	1
	Community safety net	1	0.28
Access to Advanced Education	Years of tertiary schooling	2	0
	Women's mean years in school	16	0
	Inequality in the attainment of education	0	0.50
	Number of globally ranked universities	10	0
	Percent of tertiary students enrolled in globally ranked universities	6	0

## APPENDIX D. SENSITIVITY ANALYSIS

We use sensitivity analysis to test the strength and rigor of the Social Progress Index and its components. Sensitivity analysis assesses the stability of country scores and rankings with respect to changes in the framework. First, we test the aggregation of the Index into a composite, multidimensional score and use the same analysis at the dimension level. We also test the importance of each component in contributing to the overall Social Progress Index score, as well as analyze the effect of using principal component analysis for weighting as opposed to equal weighting of indicators.

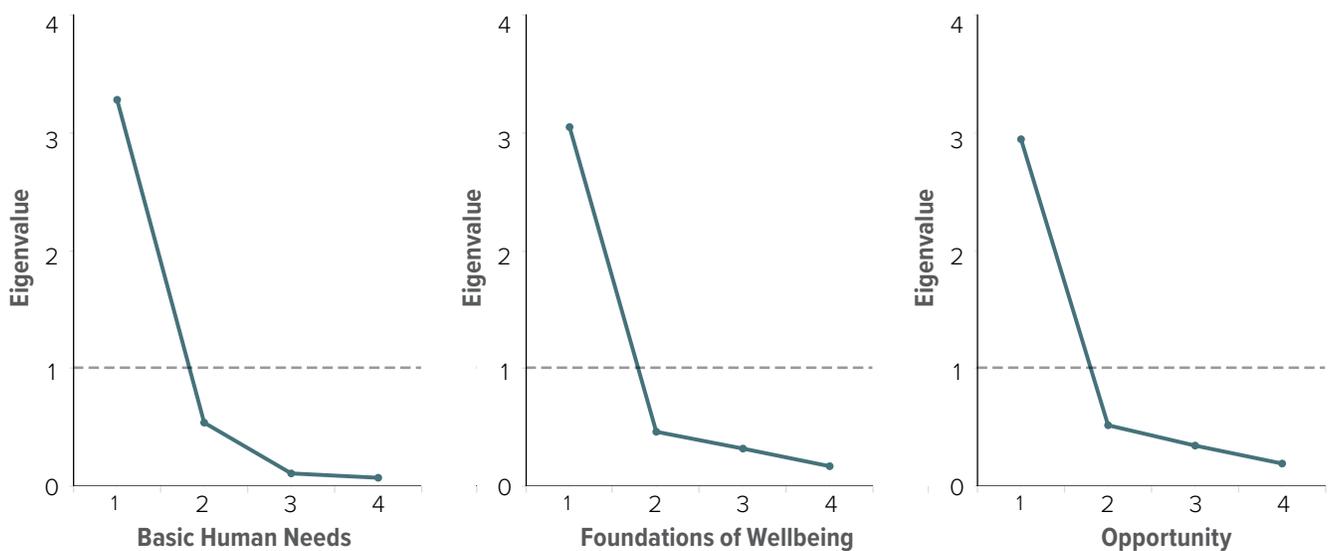
Overall, we find that the framework of the Social Progress Index is robust in its multi-dimensionality. The twelve components of the Index contribute to a common factor, both within dimensions and in aggregate across the Index framework. Furthermore, most of the twelve components contribute in a balanced manner, such that the absence of one component does not drastically affect the resulting scores and ranks of most countries. Finally, we find that the use of Principal Component Analysis (PCA) strengthens the reduction of multiple variables into one aggregate component score.

### Assessing the Multidimensionality of the Index

The Social Progress Index is composed of three dimensions and twelve components. Applying PCA across the twelve components of the Index, we find that they fall into three underlying dimensions, two of which carry an eigenvalue higher than 1 and the third with an eigenvalue of 0.59. An eigenvalue of 1 denotes a significant sub-dimension. The exercise confirms the multidimensionality of the overall Index, and shows the components are interrelated, contributing to a common factor. Furthermore, we find that all twelve components contribute to the principal factor with the same orientation and balanced weights.

The same analysis can be applied to the three dimensions. Within each dimension, PCA results show that there is only one significant underlying factor. The contributions of each component are relatively balanced. In Basic Human Needs, we find that Personal Safety contributes somewhat less.

Figure M.12 / Scree Plot and Factor Loadings by Dimension

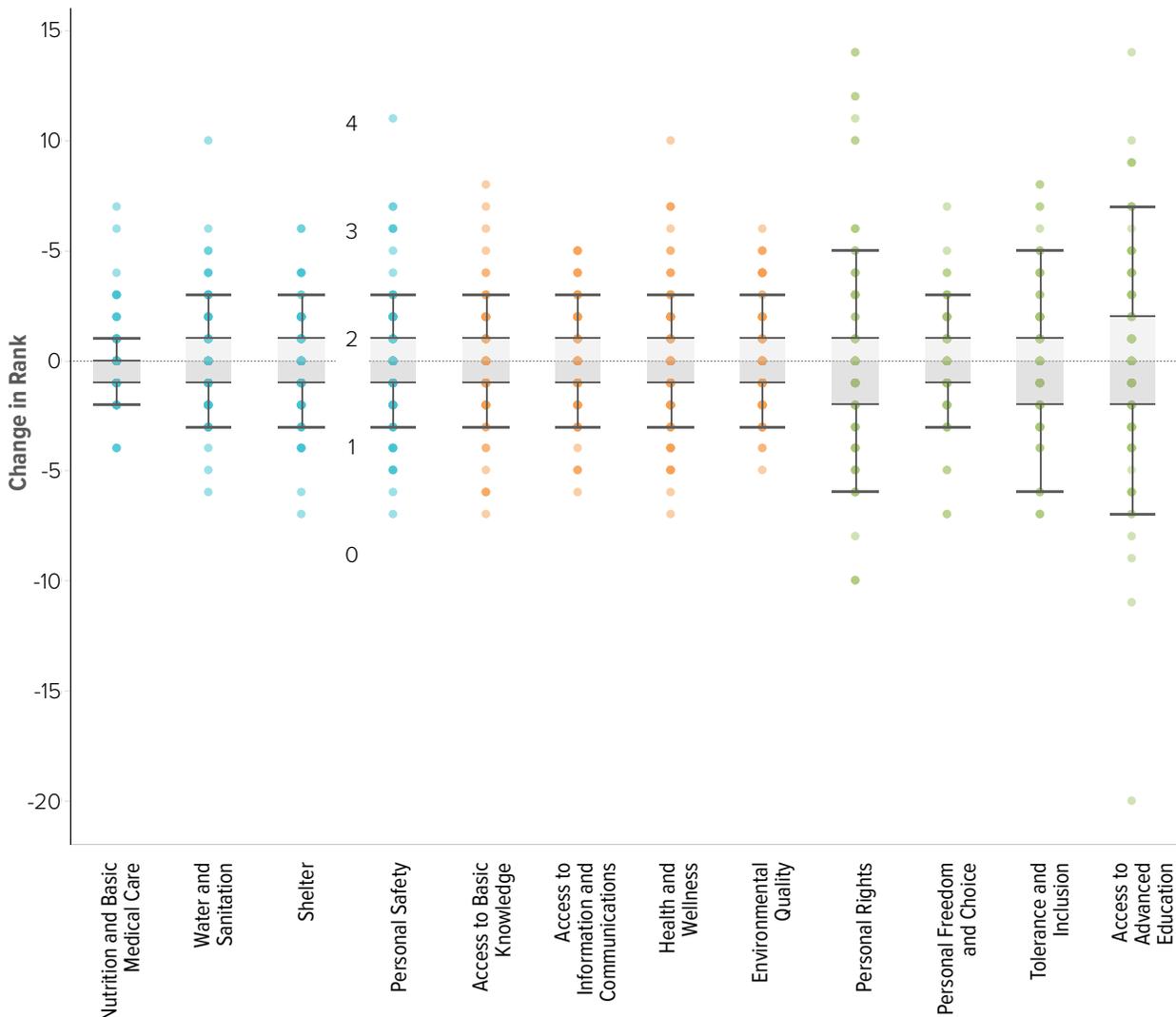


### Determining the Contribution of Each Component

The Social Progress Index is built upon the assumption that each component is of equal importance. As such, we test the effect of removing one component at a time on country rank. High differences between the rank with all components and the modified rank with a component missing indicate a stronger contribution of a component to the overall SPI score. We would expect that all components contribute relatively equally to the overall SPI score.

As shown in the figure below, the effect of removing one component at a time is moderate with respect to nearly all twelve components. In most cases, rank changes by no more than 10. Within the Personal Rights and Access to Advanced Education components, we find more cases in which rank changes by 10 or more place, suggesting these two components have slightly more influence on overall Social Progress Index rank than other components. This result is likely attributed to the ordinal nature of some of the indicators within these components.

Figure M.13 / Change in Social Progress Index Rank, Component Exclusion



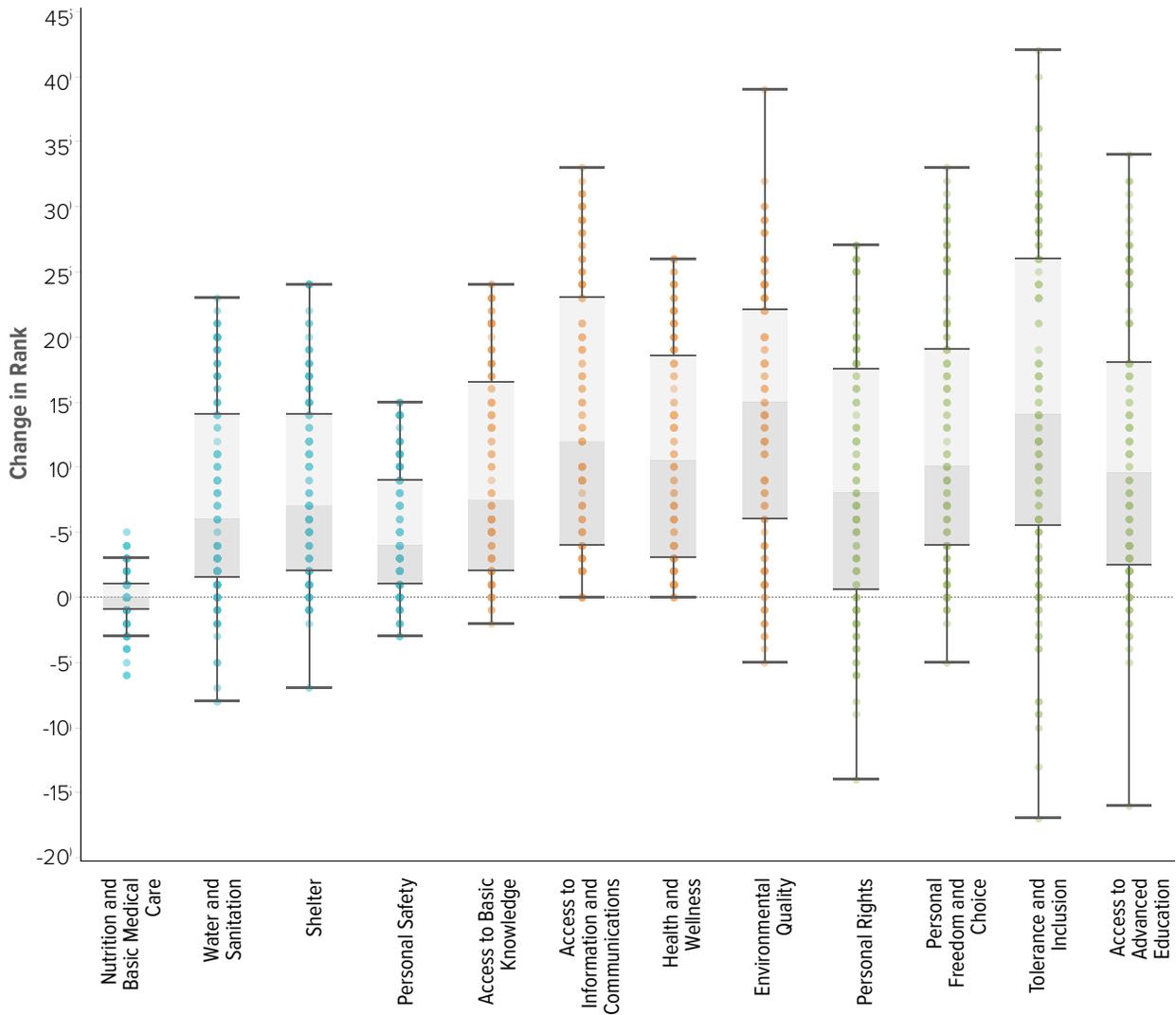
## Weighting the Indicators

Indicators within each component are weighted using PCA, which corrects for overlapping information between indicators. This is an important piece of the Social Progress Index methodology: we expect indicators within each component to be correlated with one another to some extent since they measure a similar concept. However, they cannot be perfectly correlated with one another, nor can they have little in common. Therefore, some technique of correction is necessary rather than merely weighting indicators equally.

We assess the change in country rank applying PCA weights against applying equal weights across all

aspects of the Index (overall SPI, dimensions, and components), finding that the Opportunity dimension is particularly affected by this technique. Rank in Opportunity change by more than 40 in some cases with equal weighting across the indicators. Within the components of this dimension, the greatest changes are seen in Personal Freedom and Choice. The wide band of changes in ranking likely results from the higher weight assigned to freedom of religion when the indicators are equally weighted. Freedom of religion weakly correlates with the other four indicators within the component. However, it is conceptually important to include. Our analysis shows that PCA can help correct for the relationships between indicators, while preserving the framework's conceptual basis.

Figure M.14 / Change in Social Progress Index Rank, PCA vs. Equal Weighting



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