CHAPTER 1.2

Assessing the Sustainable Competitiveness of Nations

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In recent years, citizens, the business community, and governments have become more cognizant of the impacts that the economic growth model of the past decades may have on the natural environment and the development of cohesive societies. Data on economic growth and employment show that, in the period after World War II in Western economies, economic growth went hand in hand with improving living conditions, access to more and better goods and services for a growing portion of the population, and an overall enhancement of well-being. More recently the sharp rises in economic growth in developing and emerging markets have pulled hundreds of millions of people out of poverty, dramatically improving their living conditions.

However, aggregate statistics may not fully reflect the potential negative effects that these patterns of economic development might have had either on those portions of the population who find themselves unable to benefit from the overall improving economic conditions, or on the natural environment.

A number of events and trends have raised concerns about the social sustainability of the existing development model. These include the events that led to what became known as the "Arab Spring"; the rise of unemployment in many Western economies, particularly in segments of the population such as the young and the less skilled; and increasing inequalities of income and socioeconomic opportunities in both Western countries and fast-growing Asian economies.[1]

Moreover, in terms of environmental sustainability, the existing (consumption-driven) economic model coupled with a rising population has brought about increasing pressure on natural resources such as water, energy, and mineral resources, which are becoming scarcer in the face of rising demand. The undesirable environmental consequences of human activity, such as pollution, are leading to a less habitable world. The unpredictable consequences of climate change are also raising the costs of environmental management. Together, these alterations call into question the feasibility of an economic model that does not fully take them into account.

As a result, social and environmental sustainability have become increasingly significant components of, and complements to, economic performance. Consequently they need to be properly understood and measured in order to inform policies that will set and achieve the desired objectives, and to better track progress toward higher levels of sustainable prosperity.

EXISTING EFFORTS TO DEFINE AND MEASURE SUSTAINABILITY: IDENTIFYING KNOWLEDGE GAPS

In response to this growing desire to better understand and measure the relationship between economic growth and sustainability, a vast and rapidly growing literature has developed. Examples of this seminal work include

Box 1: Advisory Board on Sustainability and Competitiveness

The Advisory Board on Sustainability and Competitiveness advises the World Economic Forum on integrating the concept of sustainability more fully into *The Global Competitiveness Report.* Members are drawn from the network of Global Agenda Councils (GACs), the World Economic Forum's knowledge backbone. They represent voices from key business sectors, government, and civil society.

- **James Cameron,** Chairman, Climate Change Capital, United Kingdom
- **Dan Esty,** Commissioner, Connecticut Department of Energy and Environmental Protection, USA
- **Edwin J. Feulner Jr.,** President, The Heritage Foundation, USA
- **Clément Gignac,** Minister of Natural Resources and Wildlife of Quebec, Canada
- **Jeni Klugman,** Director for Gender, The World Bank, USA
- **Marc A. Levy,** Deputy Director, Center for International Earth Science Information Network, Columbia University, USA
- **John W. McArthur,** Senior Fellow, UN Foundation & Nonresident Senior Fellow, Brookings Institution
- **Kevin X. Murphy,** President and Chief Executive Officer, J.E. Austin Associates Inc., USA
- **Mari Elka Pangestu,** Minister of Tourism and Creative Economy, Indonesia
- **Xavier Sala-i-Martín,** Professor, Economics Department, Columbia University, USA
- **Mark Spelman,** Global Head, Strategy, Accenture, United Kingdom
- **Simon Zadek,** Senior Visiting Fellow, Global Green Growth Institute (GGGI), Republic of Korea

the application of economic theory to environmental issues that find their roots in Katharine Coman's article on the problem of commons for irrigation in 1911. Since then, numerous contributions have included the environment in endogenous growth models as an input of production functions and as a constraint in utility maximization problems.[2] The highly influential *Stern Review on the Economics of Climate Change* in 2006 also analyzed and calculated the economic costs associated with the emissions of particles causing climate change.

Many other studies have looked at the relationship between economic growth and inequality or economic growth and social cohesion, analyzing the potential costs of increased inequalities that can result in social and political tensions, riots, and the inability of societies to mobilize all available productive resources as well as the relationship between economic growth and the rise of long-term structural unemployment.[3] Yet evidence from different countries is inconclusive about the relation existing between income inequality and growth.

Significant efforts have been made over recent decades to devise methods and metrics for capturing the concept of sustainability. For example, the concept of *triple bottom line accounting,* which emerged in the 1980s, has been a serious attempt to expand the traditional reporting framework for companies and countries to take into account environmental and social performance as well as financial and economic performance. The work of the Stiglitz-Sen-Fitoussi Commission in 2008 also reflects a remarkable attempt to expand the measurement of prosperity in societies "beyond measures of market activity to measure well-being." International organizations have also embraced these efforts. The European Commission, for example, has integrated sustainability objectives into its growth strategy: "The Europe 2020 Strategy, for smart, inclusive and sustainable growth."[4] The Organisation for Economic Co-operation and Development (OECD) is undertaking the Better Life Initiative, measured by the Better Life Index,[5] which includes social and environmental sustainable metrics; and, finally, the United Nations Development Programme (UNDP) has also included the concepts of environmental sustainability and equity in its human development assessment.[6]

All these efforts to integrate environmental and social sustainability metrics better into mainstream development thinking have been possible thanks to the ongoing attempts to improve the indicators in these fields, which are still not widely available. In terms of metrics on environmental sustainability only, the Environmental Performance Index (EPI), and its predecessor the Environmental Sustainability Index, developed by researchers at Yale and Columbia universities;[7] the Ecological Footprint, developed by the Global Footprint Network;[8] and the Global Adaptation Index,[9] created by the Global Adaptation Institute, have been pioneers in measuring the ecological resource use and resource capacity of countries.

For social sustainability, fewer attempts have been made. Among others, we could highlight the World Bank's *Worldwide Governance Indicators Framework,* which measures different aspects of governance such as political instability, voice, and accountability;[10] and the International Labour Organization's Decent Work initiative, which aims at measuring various elements relevant for labor conditions.[11]

In recent years, the World Economic Forum has been at the forefront of the discussion on environmental sustainability, working to shape the agenda by catalyzing international public-private platforms that help governments draw on private expertise to co-design robust proposals for addressing a large variety

of environmental issues. More generally, the Forum has found itself at the intersection of this discussion as a key convening platform for debating and developing a better understanding of what these different aspects of sustainability require from the international community and national policymakers as well as business leaders. Issues of economic, social, and environmental sustainability have been showcased and discussed at many of the Forum's regional and annual meetings.

Although much progress has been made in recent years, several knowledge gaps remain in terms of fully understanding and measuring the relationship between economic growth and environmental and social sustainability as well as how it affects the ability of countries to boost their sustainable prosperity and that of their citizens. Against this backdrop, the World Economic Forum—in collaboration with a multi-stakeholder Advisory Board of international experts (Box 1)—embarked on an effort to integrate sustainability concepts into its competitiveness work. The results of our preliminary work were released in last year's edition of *The Global Competitiveness Report.*

We have continued to work on the topic over the past year. This chapter describes the evolution in our thinking about *sustainable competitiveness,* a newly coined term describing a concept not sufficiently understood. This work has a threefold objective:

1. to deepen our understanding of the concept of sustainable competitiveness as the key driver of sustainable prosperity, and of the complex relationships between the determinants of long-term economic growth and social and environmental sustainability;

2. to provide a preliminary comparative assessment of where individual economies stand on various elements of sustainable competitiveness, as defined by the World Economic Forum; and

3. to call the attention to the lack of high-quality data that would allow countries to fully understand how they fare in these critical areas. Without an improvement in the quality and availability of sustainability data, countries will have trouble monitoring the rise or decline in the prosperity and quality of life of their citizens, and therefore it will be difficult for them to determine policies that would be appropriate to put into place.

DEFINING SUSTAINABLE COMPETITIVENESS: BRIDGING THE KNOWLEDGE GAPS

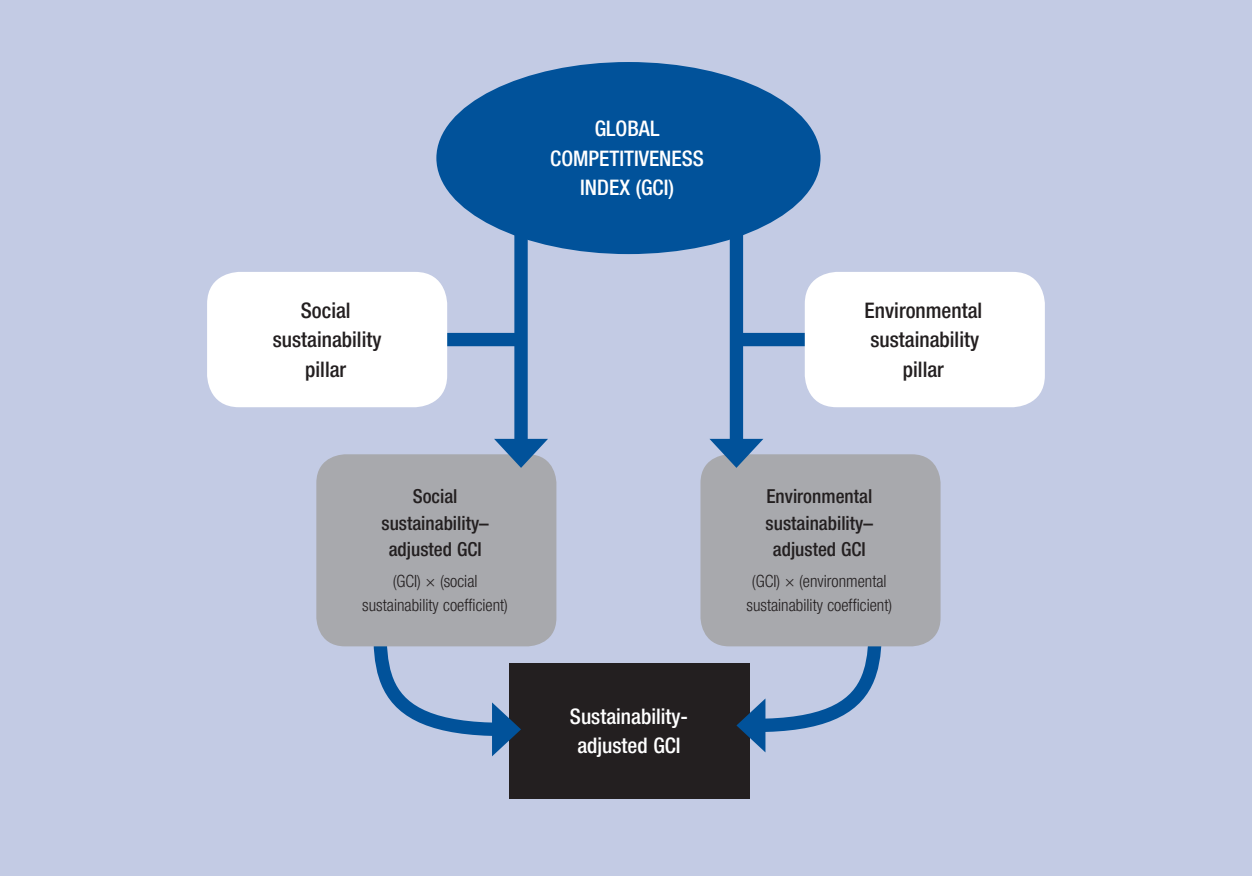
As mentioned above, a great deal of work has been done to advance our understanding and to measure the concept of sustainability, yet little work has been carried out at the intersection between competitiveness and sustainability to elucidate the nature of their relationship. The World Economic Forum's ongoing efforts in the area of sustainable competitiveness aims at bridging this gap by identifying the complex elements of these relationships and providing a working definition of the concept. The central idea of sustainable competitiveness reflects the search for a development model that would balance economic prosperity, environmental stewardship, and social sustainability.

The first relationship to analyze is the one between competitiveness and environmental sustainability, which comprises aspects such as pollution, resource scarcity, water availability, and the regulatory framework as far as it pertains to environmental policies and measures. A high-quality and well-managed natural environment is related to robust national competitiveness through multiple channels. It enables the efficient use of resources and ensures that future generations will be able to count on them to meet their own needs. A high-quality natural environment also supports a healthy workforce, circumventing the damaging effects on human capital (such as illness and diminished human capital productivity) that can be brought about by pollution and other forms of environmental degradation. Finally, environmental degradation may directly reduce the productivity of sectors such as agriculture, which in turn can have negative implications both for the economy (especially for countries where GDP is heavily dependent on agriculture) and for matters of food security.

More generally, environmental degradation, via climate change for example, can erode the quality of living conditions. Changes in temperature alone can have a direct impact on the economy via decreased crop productivity and increased volatility of commodity prices.[12] For instance, in July 2012 the price of corn soared by 23 percent because of the unprecedented drought in the United States, and the price of sugar increased by 12 percent because of untimely rain in Brazil.[13]

Another direct negative impact on the economy occurs through climate-related natural catastrophes that damage infrastructure. In turn, these events will divert available resources from productivity-enhancing investments, such as education and innovation, for reconstruction purposes. According to an estimate of the 2007/2008 UN *Human Development Report,* to reach the Millennium Development Goals by 2015, the additional cost associated with coping with a more hostile climate will be approximately US$85 billion per year. In 2011, unprecedented floods in Thailand cost its economy US$45 billion, according to the World Bank, and triggered disruptions to many global supply chains. China has recently experienced its worst drought in 60 years, with over 4 million farmers facing severe water shortages. Finally, environmental sustainability affects biodiversity and the quality of the habitat, which has

Figure 1: The structure of the sustainability-adjusted GCI



Note: Refer to appendix A for a detail explanation of the methodology.

implications for human living conditions. Recent floods in the Philippines have claimed at least 1,500 lives, with corresponding negative impacts to infrastructure and land. And in 2010, 17 million people were affected by floods in Pakistan, making it that country's most expensive natural disaster, while an autumn drought in the Amazon brought river flow to its lowest level since 1902 in some parts.[14]

Based on this analysis and the relationship between different elements of environmental sustainability and competitiveness, our definition of *environmental sustainability* is *the institutions, policies, and factors that ensure an efficient management of resources to enable prosperity for present and future generations.*

The second relationship to analyze is the one between competitiveness and social sustainability. Typically, higher levels of competitiveness produce higher levels of economic growth and therefore prosperity for societies, raising the well-being of citizens, who can consume more available goods and services. However, in some cases—when the generated wealth does not reach some parts of the population, who thus remained marginalized—higher levels of competitiveness may not lead to higher levels of social sustainability. Those societies in which parts of the population cannot contribute to economic activity or where income disparities are very high are those that likely do not benefit from the full potential of their resources and are more prone to social unrest, affecting the efficiency of economic production.

Based on this analysis, our definition of *social sustainability* is *the institutions, policies, and factors that enable all members of society to experience the best possible health, participation, and security; and that maximize their potential to contribute to and benefit from the economic prosperity of the country in which they live.*

The third and final relationship to analyze is the one between environmental and social sustainability. High levels of poverty and inequality may lead to massive unplanned urbanization, such as slums, where large segments of the population do not have access to basic services. Such living conditions can have significant repercussions for the environment, including the destruction of the natural environment via deforestation and the pollution of water resources because of a lack of waste management.[15]

Based on the relationships between competitiveness and environmental and social sustainability described above, our definition of *sustainable competitiveness* is *the set of institutions, policies, and factors that*

make a nation remain productive over the longer term while ensuring social and environmental sustainability. Fundamental to this concept is the notion that, while competitiveness can be equated with productivity and economic performance, sustainable competitiveness can be linked to a broader concept that focuses on aspects that go beyond mere economic performance to include other important elements that render societies sustainable by ensuring high-quality growth. Another way of looking at the concept of sustainable competitiveness is that it aims to gauge not only whether a country has the potential to be prosperous and to grow over the medium and long term, but also whether the national development process contributes to the kind of society in which we want to live.

MEASURING SUSTAINABLE COMPETITIVENESS: THE CONCEPTUAL FRAMEWORK

Based on our definition of sustainable competitiveness, we have developed a framework that aims to create a common ground to develop policies that balance economic prosperity with social inclusion and environmental stewardship.

This conceptual model is represented in Figure 1, which presents a framework where the Forum's index for measuring competitiveness, the Global Competitiveness Index (GCI), is adjusted by factors that encompass social and environmental sustainability.

This framework highlights the central position of competitiveness as the key driver of prosperity in society. High levels of competitiveness are crucial to sustained prosperity. The GCI measures the level of competitiveness of an economy, as discussed in Chapter 1.1, defined as *the set of institutions, policies, and factors that determine the level of productivity of an economy.* The GCI is a comprehensive index that takes into account 12 pillars or drivers: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation. The variables that are analyzed in each of these 12 pillars are well known and benefit from more than 30 years of ongoing work on competitiveness at the World Economic Forum.

However, the framework presented in Figure 1 also indicates that competitiveness on its own may not lead to sustainable levels of prosperity. The attainment of a certain level of economic prosperity is essential for improving high standards of living. However, within this exercise, countries are assessed for their ability to generate this prosperity for their citizens in a sustainable way. In other words, competitiveness is a necessary but not sufficient condition for prosperity—hence the need for social sustainability–adjusted and environmental sustainability–adjusted measures of competitiveness.

Box 2: Our evolving approach to measuring sustainable competitiveness

In the 2011–2012 edition of *The Global Competitiveness Report,* a beta version of a Sustainable Competitiveness Index (SCI) was presented in Chapter 1.2. It incorporated most of the elements of the World Economic Forum's existing Global Competitiveness Index (GCI), as described in Chapter 1.1, as well as a number of new elements, including a "social cohesion" pillar and a number of measures of environmental stewardship and the efficient use of resources. A comparison was then made between the results of the GCI and the SCI to provide a sense of the extent to which countries are competitive today while also preparing for a strong performance in the future.

The project team has continued to work with the Advisory Board over the past year to refine the concept of sustainable competitiveness. Important input has also been provided by numerous structured discussions with multi-stakeholder experts on the topic at the Forum's regional and annual events, as well as through a specific workshop with experts focused on social sustainability indicators.

We came to recognize through these consultations that a key limitation of the beta version of the SCI framework was that the GCI components were redistributed within the SCI. This arrangement made it difficult to decipher whether the differences between GCI and SCI scores were the result of the reorganization, which led to changes in weightings, or the result of the additional sustainability measures.

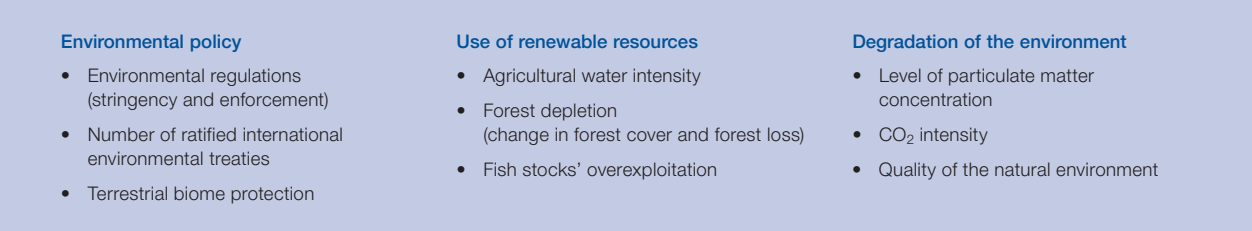
Based on this experience, the decision was taken to "unbundle" the sustainability factors in order to isolate their relationship with competitiveness more clearly. Rather than calculating a separate index, the GCI is now at the heart of the analysis. The impact of the social and environmental sustainability pillars are added to create a measure of sustainable competitiveness.

With the GCI as its core, as captured visually in Figure 1, two additional pillars have been constructed to capture this concept. One captures environmental sustainability and the other captures social sustainability. This approach builds on the work presented last year, but makes the results much more transparent and easy to interpret.

Our definition of *sustainable competitiveness* has also evolved somewhat over the past year. In the beta version of the work, a "competitiveness vulnerability" approach was put forward, assuming that sustainability indicators mattered more over the longer run. However, recognizing that sustainability and competitiveness are both medium- to long-term concepts, we have moved to the broader idea of sustainable competitiveness that is related to notions such as sustainable prosperity and quality growth, as described in the text of this chapter.

Defining the functional relationship between competitiveness and sustainability and identifying and measuring the pillars and variables that are driving environmental and social sustainability are not easy tasks. There is not yet sufficient evidence to suggest any type of functional relationship among them; we therefore opt for the simple approach of defining a linear relationship among the three dimensions. As a result, the final overall sustainability-adjusted Global

Figure 2: Summary of indicators for environmental sustainability



Competitiveness Index is an average of the two sustainability-adjusted indexes: the social sustainability–adjusted GCI and the environmental sustainability–adjusted GCI (Box 2).

With regard to the pillars and variables that define environmental and social sustainability, we follow the logic and definitions that we covered in the previous section.

Environmental sustainability pillar

To develop the **environmental sustainability** pillar, the Forum has worked closely with experts at Yale's Center for Environmental Law and Policy (YCELP) and with the Center for International Earth Science Information Network (CIESIN) at Columbia University's Earth Institute to define the best existing indicators to use in this area and to understand the shortcomings of these data. The measures captured here and presented in the environmental sustainability pillar are meant to complement the broader analysis carried out through the Environmental Performance Index (EPI) produced by these two organizations, which provides a much more comprehensive indication of national performance on a variety of environmental indicators.

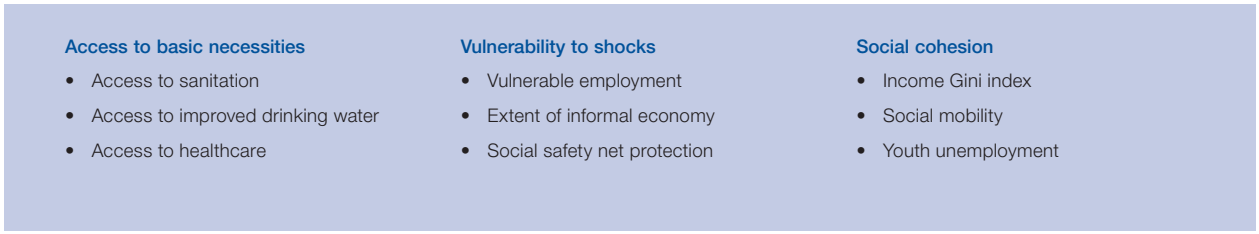
In this pillar, indicators have been aggregated into different categories (see Figure 2) aimed at covering the most relevant aspects for environmental sustainability.

The first area measured in the environmental sustainability pillar is *environmental policy,* which is composed of a gauge of the stringency and enforcement of environmental regulation along with the extent to which land areas are protected, providing an assessment of a country's commitment to protecting natural capital. Another measure of policy is provided by the terrestrial biome protection indicator, which assesses whether at least 17 percent land area of each habitat type is under official protection. We also include a measure of the number of key international environmental treaties, out of a total of 25 ratified by individual countries. This variable demonstrates the country's level of engagement with environmental issues and thus its willingness to become involved in international efforts toward addressing global environmental challenges. Together these variables capture to some extent the political will of countries to respond to environmental issues in a structured and consistent way and indicate their importance in the government agenda.

The second area relates to the *use of renewable resources.* These indicators comprise measures of water withdrawal intensity of agriculture in an economy, which considers the extent to which the agriculture sector is efficient in its use of water; forest depletion, which takes into account reported and satellite information to assess the percentage of total land area that is deforested (or afforested) over time; and the exploitation of fishing grounds. A diminishing regenerating capacity is one of the major environmental issues for which a simple solution is not easily identified. Although the data in this area are among the most difficult to collect and interpret, it is crucial for a country to manage these resources in order to ensure that they do not run out of them before future generations can enjoy them.

The third area takes into consideration the *degradation of the environment,* which can cause serious damage to human health while destroying the ecosystem. The specific indicators used to measure this concept are the level of particulate matter concentration, the quality of the natural environment, and CO_2 intensity. Particulate matter concentration is a proxy for air pollution, which has proven effects on human health and is monitored by local authorities in many countries. The quality of the natural environment is a perception-based assessment of the local status of the environment that measures the observation of local business leaders on the ground. CO_2 intensity is a measure of the efficiency of energy use in relation to the emissions it produces. It is important to note that, although CO_2 intensity also provides a sense of national contributions to climate change, at present, the decision was taken to not include climate change as a specific factor in this pillar. This is because there is currently no agreement on how to allocate emissions to particular countries. For example, in a world of globalized markets, should emissions be allocated to the country producing the goods that created the emissions, or to the consuming country? Also it is not yet clear what impact countries' contributions to climate change would have on national competitiveness, particularly in the absence of an international agreement that would impose costs on large emitters.

Figure 3: Summary of indicators for social sustainability



Social sustainability pillar

For **social sustainability,** the Forum identifies three conceptual elements (Figure 3). The first category aims to assess a *population's access to basic necessities* (lack of access to basic necessities indicates a state of poverty). It includes three indicators: access to sanitation, access to improved drinking water, and access to healthcare services. This category is thus a measure of inclusion as well as a measure of the fulfillment of basic physical needs. Other indicators that might be considered relevant and we would have liked to incorporate but could not because of the lack of data include access to decent housing and food security. A population with poor access to water, food, shelter, healthcare, and sanitation cannot develop to its full capacity.

The second category is linked to the concept of perceived economic security. Hence it aims to evaluate a *population's vulnerability to economic exclusion.* Three indicators have been chosen for this evaluation: vulnerable employment as a percentage of total employment, the extent of informal economy, and social safety net protection. The vulnerable employment indicator measures the percentage of people who are self-employed in a small business or are in a small family business that may provide income levels insufficient to meet the living standards of the country of citizenship and can prove unstable in times of economic difficulties. The extent of the informal economy provides a sense of how well integrated the workforce is into official structures. A workforce that is less integrated leaves workers more vulnerable to concerns related to job loss, old age, maternity, disability, or illness. Third, the social safety net is a complementary measure of protection: in times of financial and economic instability, it allows households to maintain their quality of life and weather crises without falling into poverty traps. Providing protection also leads to a sense of financial security that enables individuals to undertake investments and entrepreneurial risk, feeding back into economic activity.

The third and last category assesses *social cohesion.* The assessment includes three indicators: the income Gini index, social mobility, and youth unemployment. We include the income Gini index as a measure of income inequality (see Box 3), but keeping in mind that—from a normative approach—excessive inequality may hide relative poverty that would prevent lower-income families from accessing the same opportunities as those with incomes at the high end of the range in the society. Linked to this idea, in this edition of the *Report* we introduce a (Survey-based) indicator on social mobility: in the context of sustainable competitiveness, it is crucial that subsequent generations can improve their condition regardless of the socioeconomic status of their parents. From a purely economic perspective, the absence of such social mobility can be detrimental to human capital development because skilled individuals, in a society that does not allow them to advance, might choose to migrate; if they stay, their skills will not be leveraged by the economy in which they live. Additionally, low expectations for the future in a context characterized by unemployment and inequality can also converge to spark political instability. Third, on a broader conceptual level, social mobility is a direct measure of the freedom to pursue human development. Finally, high youth unemployment can reduce social cohesion and provoke significant economic and social costs, depressing lifetime earnings for unemployed workers, taking a toll on their health and putting at risk the health and educational success of the children of unemployed parents. From an economic standpoint, high youth unemployment reflects a failure to mobilize existing resources and build productive skills, and it suppresses aggregate demand, eroding business confidence and therefore the prospects for investment and employment creation.

While the variables we have described capture a number of important aspects of social sustainability, it is important to note that additional variables would be needed to obtain a more complete measure of the concept. These indicators include measurements of social participation and respect for core human rights, as well as discrimination and the treatment of minority populations. However, as noted in Box 4, because of the lack of quality indicators in these and other areas we are unable to include them for the time being.

Box 3: The income Gini index

The income Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. Theoretically, it measures inequality within a range of 0 to 100, where a value of 0 represents perfect equality (everyone has the same income) and a value of 100 perfect inequality (for example, one person or household could earn all the income). It is the most popular indicator of inequality because it provides an intuitive interpretation in a context in which most other similar indicators are difficult to present to a broad non-technical audience. Consequently it is calculated by leading institutions (such as the World Bank), which makes it the most easily available indicator for a large number of countries. Its wide coverage also contributes to its widespread use.

However, there are a number of elements that policymakers and researchers should take into consideration when using this measure. From a technical point of view, the Gini index measures relative income distributions regardless of actual income. This means that, hypothetically, even in case of low inequality, a large part of the population would still hardly be able to cover basic necessities. Second, different income distributions can yield the same Gini index. Consequently, when considering different groups within the same population, it is not possible to break down the inequality either in a *within* group component or *between* groups component.

From a policy point of view, this means that the Gini index does not allow the inequality of one particular population group to be measured. It also does not assess the extent to which those with high incomes have contributed to the growth of the entire economy. Seen from a different angle, although the Gini index helps to measure equality/inequality within a society, it does not indicate what the normative or desirable level of inequality should be. For example, although there may be a societal consensus that innovative and highly skilled members who contribute disproportionately more to economic growth should receive a higher share of income than those who contribute less (so as to provide the right incentives to contribute overall), it is unclear how much the high contributors should receive—that is, to what extent differences in skills should be reflected by higher shares of national income. One way to gain some preliminary insights about optimal values is to combine a statistical approach by assessing cross-country distribution performances with qualitative indicators of the economy.

Practically, this unresolved issue has important consequences when assigning a score to and comparing economies. For example, although the Gini index measures inequality in the theoretical span of 0 to 100, the actual distribution in our sample ranges from approximately 24 to 64. This suggests that a value of 100 is practically not feasible; in other words, empirically a score of 60 already suggests strong inequality compared with the theoretical value of 100. However, values close to 0 are also not observed and probably not optimal.

To conclude, in the absence of better measures, we use the Gini index as the best available proxy for income distribution, yet some caution should be used in the process of drawing conclusions based on this indicator alone. Qualitative data and other information should complement this measure.

MEASURING SUSTAINABLE COMPETITIVENESS: METHODOLOGY

In the 2012 edition of the sustainable competitiveness framework, the two areas of sustainability—social and environmental—are treated as independent adjustments to each country's performance in the Global Competitiveness Index (GCI). The details behind the aggregation are described in Appendix A; Appendix B provides detailed notes and sources for each indicator.

The aggregation leads to three outcomes: an environmental sustainability–adjusted GCI, a social sustainability–adjusted GCI, and an overall sustainability-adjusted GCI that combines both effects.

Lacking clear theoretical guidelines for assigning weights to the individual elements, each indicator has been given an equal weight within each pillar. As described in detail in Appendix A, each pillar is converted into an "adjustment coefficient" with a range from 0.8 to 1.2, which is then used to adjust the GCI score upward or downward within this range. This results in an adjusted score of a maximum of 20 percent lower or 20 percent higher than the underlying GCI score.

It is important to highlight that, because several aspects of sustainability are assessed in the social and environmental sustainability pillars, the results reflect the overall performance of all the aspects rather than one particular element. In a sense, this means that poor performance in some aspects can be compensated for by strengths in other areas.

This can produce some potentially counterintuitive results—for instance, Brazil gets a positive rating for environmentally sustainable competitiveness because it receives strong assessments on a number of indicators, although it has one of the highest rates of deforestation in the world.

Country coverage

Instead of the 144 economies covered by the GCI, in this analysis we cover a subsample of 79 countries for which we have been able to gather sufficient data.[16] Data availability represents a major challenge and constraint in this exercise because, for many of the concepts we are trying to capture, no measures exist or data are available for only a limited number of countries (such as those in the OECD, the G-20, and the European Union). The goal for future research is to include an increasing number of countries in the analysis as such data become more readily available.

Box 4: Concepts not yet captured by the sustainable competitiveness analysis and areas for future research

There are a number of areas that we recognize as critical for sustainable competitiveness but that have not yet been included in our analysis because of a lack of relevant data. Our goal is to include and update these elements and more accurate indicators as relevant and improved data become available in coming years.

- *Inclusion of minorities.* There is some evidence that excluding minorities can cause political instability, but no data are available to assess the actual level of cohesion of different ethnic groups in a country.
- *Working conditions.* In the context of social sustainability it is desirable, to meet a certain level of safety conditions and to ensure that salaries are sufficient to enable full participation in the country's prosperity. Although the International Labour Organization has published statistics on the quality of working conditions, the data available cover only a limited number of economies. Until such data are available for a wide range of countries, they cannot be considered for a global assessment.
- *Water pollution.* Water is one of the most critical resources for human life as well as for economic activity. The availability of clean water determines the health of the population and indirectly affects migration patterns. Managing water efficiently comprises minimizing the water use as well as keeping the water tables fully usable. Unfortunately data on water quality are scarce.
- *Recycling.* Being able to re-use material is critical to keep producing new goods without depleting the mineral and natural resources available. A measure of how much of the material incorporated in consumer goods is actually re-used would constitute a good benchmark for countries' exposure to resource scarcity.
- *Waste management.* Directly linked to recycling, managing waste is essential for establishing a culture of recycling as well as to avoid the careless disposal of dangerous materials that have impacts on the health of the population. Unfortunately data that can measure the management of waste are not yet available.

Table 1 shows how the Global Competitiveness Index score is affected once sustainability indicators are taken into account.

SELECTED RESULTS OF THE SUSTAINABILITY-ADJUSTED GCI

Based on the initial results presented above, a number of general preliminary conclusions can be drawn:

1. There are no necessary trade-offs between being competitive and being sustainable. The analysis found a positive correlation across the three dimensions of competitiveness and social and environmental sustainability.

2. A corollary of the first point is the fact that political will is essential to achieving sustainable competitiveness. There is no physical law preventing any country from being on a sustainable path; political will and good public management are the keys to achieving this goal. This understanding is also reflected in some theoretical literature.[17]

3. Europe is overall the most "equal" region in terms of income. The European social model places 18 countries in the top 20 for the lowest income Gini index indicator. However, on a broader scale, the social sustainability of Europe shows a divide similar to that of its internal competitiveness, with the Southern European economies diverging from the Northern economies.

In addition, a number of country-specific and regional conclusions can be drawn.

Switzerland leads the rankings of the sustainability-adjusted GCI, performing well in all aspects of sustainable competitiveness and demonstrating that there are not necessarily trade-offs between being environmentally or socially sustainable and being competitive.

Similarly, **Nordic countries** perform well in both dimensions, with **Finland** leading the group with the highest score in both areas. All of these countries do exceptionally well in the social sustainability–adjusted GCI (Norway, Denmark, Finland, and Iceland all score among the top 10 economies). **Sweden,** however, registers a relatively high youth unemployment rate (25.2 percent), which determines its slightly weaker performance. **Norway** stands out especially for attaining the best score in the income Gini index while performing well—within the top 10—across all the social sustainability indicators. The Nordics also have good results in the environmental sustainability–adjusted GCI, although they share the common concern of overfishing.

Japan receives an overall relatively positive assessment in the sustainable competitiveness analysis. On the social sustainability pillar, Japan performs better thanks to a low rate of youth unemployment (perhaps not surprising given the aging population) and a small informal economy; however, it also carries a relatively

Table 1: Adjustment to the GCI scores by sustainability indicators

	GCI 2012–2013		Social sustainability–adjusted GCI**		Environmental sustainability–adjusted GCI†		Sustainability-adjusted GCI††	
Country/Economy	Rank*	Score	Score	Direction	Score	Direction	Score	Direction
Switzerland	1	5.72	6.83	⇑	6.87	⇑	6.85	⇑
Finland	3	5.55	6.45	⇑	6.26	↗	6.36	↗
Sweden	4	5.53	6.17	↗	6.15	↗	6.16	↗
Netherlands	5	5.50	6.54	⇑	5.88	↗	6.21	↗
Germany	6	5.48	6.37	⇑	5.92	↗	6.14	↗
United States	7	5.47	5.63	⇒	5.00	↘	5.31	⇒
United Kingdom	8	5.45	6.03	↗	5.62	⇒	5.82	↗
Japan	10	5.40	6.10	↗	5.42	⇒	5.76	↗
Denmark	12	5.29	6.21	⇑	5.25	⇒	5.73	↗
Canada	14	5.27	5.93	↗	5.33	⇒	5.63	↗
Norway	15	5.27	6.32	⇑	5.98	↗	6.15	⇑
Austria	16	5.22	6.17	⇑	5.86	↗	6.02	⇑
Belgium	17	5.21	5.90	↗	5.46	⇒	5.68	↗
Korea, Rep.	19	5.12	5.37	⇒	4.41	↘	4.89	⇒
Australia	20	5.12	5.83	↗	5.08	⇒	5.46	↗
France	21	5.11	5.59	↗	5.40	↗	5.50	↗
New Zealand	23	5.09	5.82	↗	5.53	↗	5.68	↗
Malaysia	25	5.06	5.30	⇒	4.98	⇒	5.14	⇒
Israel	26	5.02	5.40	↗	4.72	↘	5.06	⇒
Ireland	27	4.91	5.26	↗	5.11	⇒	5.18	↗
China	29	4.83	4.61	⇒	4.27	↘	4.44	↘
Iceland	30	4.74	5.45	⇑	5.43	⇑	5.44	↗
Chile	33	4.65	4.53	⇒	4.43	⇒	4.48	⇒
Estonia	34	4.64	4.82	⇒	4.85	⇒	4.83	⇒
Spain	36	4.60	4.66	⇒	4.45	⇒	4.55	⇒
Thailand	38	4.52	4.39	⇒	4.16	↘	4.28	↘
Czech Republic	39	4.51	4.89	↗	4.66	⇒	4.77	↗
Panama	40	4.49	4.15	↘	4.71	⇒	4.43	⇒
Poland	41	4.46	4.32	⇒	4.42	⇒	4.37	⇒
Italy	42	4.46	4.38	⇒	4.40	⇒	4.39	⇒
Turkey	43	4.45	4.24	⇒	3.84	↘	4.04	↘
Lithuania	45	4.41	4.52	⇒	4.71	↗	4.61	⇒
Azerbaijan	46	4.41	4.08	↘	3.78	↘	3.93	↘
Brazil	48	4.40	4.22	⇒	4.69	↗	4.46	⇒
Portugal	49	4.40	4.58	⇒	4.15	↘	4.36	⇒
Indonesia	50	4.40	3.85	↘	4.21	⇒	4.03	↘
Kazakhstan	51	4.38	4.53	⇒	3.50	⇓	4.02	↘
South Africa	52	4.37	3.83	↘	3.77	↘	3.80	↘
Mexico	53	4.36	4.12	↘	3.90	↘	4.01	↘
Mauritius	54	4.35	4.40	⇒	3.66	⇓	4.03	↘

(Cont'd.)

Table 1: Adjustment to the GCI scores by sustainability indicators *(cont'd.)*

	GCI 2012–2013		Social sustainability–adjusted GCI**		Environmental sustainability–adjusted GCI†		Sustainability-adjusted GCI††	
Country/Economy	Rank*	Score	Score	Direction	Score	Direction	Score	Direction
Latvia	55	4.35	4.55	⇒	4.69	⇗	4.62	⇗
Slovenia	56	4.34	4.76	⇗	4.56	⇒	4.66	⇗
Costa Rica	57	4.34	4.30	⇒	4.69	⇗	4.49	⇒
Cyprus	58	4.32	4.63	⇗	4.05	↘	4.34	⇒
India	59	4.32	3.70	↘	3.75	↘	3.73	↘
Hungary	60	4.30	4.29	⇒	4.32	⇒	4.30	⇒
Peru	61	4.28	3.73	↘	4.03	↘	3.88	↘
Bulgaria	62	4.27	4.17	⇒	3.97	↘	4.07	⇒
Jordan	64	4.23	4.25	⇒	3.58	⇓	3.92	↘
Philippines	65	4.23	3.82	↘	4.16	⇒	3.99	↘
Iran, Islamic rep.	66	4.22	3.85	↘	3.85	↘	3.85	↘
Russian Federation	67	4.20	4.09	⇒	3.87	↘	3.98	↘
Sri Lanka	68	4.19	3.67	↘	4.25	⇒	3.96	↘
Colombia	69	4.18	3.47	⇓	4.01	⇒	3.74	↘
Morocco	70	4.15	3.55	↘	3.52	⇓	3.53	↘
Slovak Republic	71	4.14	4.18	⇒	4.36	⇒	4.27	⇒
Ukraine	73	4.14	4.04	⇒	3.53	⇓	3.78	↘
Uruguay	74	4.13	4.21	⇒	4.09	⇒	4.15	⇒
Romania	78	4.07	3.71	↘	3.73	↘	3.72	↘
Macedonia, FYR	80	4.04	3.66	↘	3.64	↘	3.65	↘
Croatia	81	4.04	3.84	⇒	4.20	⇒	4.02	⇒
Armenia	82	4.02	3.58	↘	3.50	↘	3.54	↘
Trinidad and Tobago	84	4.01	4.00	⇒	3.67	↘	3.83	⇒
Cambodia	85	4.01	3.31	⇓	3.93	⇒	3.62	↘
Ecuador	86	3.94	3.58	↘	3.67	↘	3.63	↘
Moldova	87	3.94	3.75	⇒	3.75	⇒	3.75	⇒
Namibia	92	3.88	3.22	⇓	3.84	⇒	3.53	↘
Argentina	94	3.87	3.59	↘	3.37	↘	3.48	↘
Serbia	95	3.87	3.48	↘	3.71	⇒	3.59	↘
Greece	96	3.86	3.59	↘	3.82	⇒	3.71	⇒
Jamaica	97	3.84	3.28	↘	3.74	⇒	3.51	↘
Dominican Republic	105	3.77	3.29	↘	3.29	↘	3.29	↘
Kenya	106	3.75	3.01	⇓	3.76	⇒	3.38	↘
Egypt	107	3.73	3.56	⇒	3.20	↘	3.38	↘
Algeria	110	3.72	3.31	↘	3.01	⇓	3.16	⇓
Paraguay	116	3.67	3.00	⇓	3.61	⇒	3.31	↘
Tanzania	120	3.60	2.88	⇓	3.60	⇒	3.24	↘
Pakistan	124	3.52	2.84	⇓	2.96	⇓	2.90	⇓
Venezuela	126	3.46	3.15	↘	3.41	⇒	3.28	↘

* This is the GCI rank, as presented in Chapter 1.1. Only the 79 countries covered by this exercise are included in the table.
** This is the score obtained by multiplying the GCI score by the social sustainability coefficient.
† This is the score obtained by multiplying the GCI score by the environmental sustainability coefficient.
†† This is the average of social sustainability–adjusted GCI and environmental sustainability–adjusted GCI scores.
Please refer to the technical appendix of this chapter for a description of how the coefficients are calculated. All the underlying indicators are available at http://www.weforum.org/content/pages/sustainable-competitiveness.

Key
⇑ GCI score changes by > +15% to +20%
⇗ GCI score changes by +5% to +15%
⇒ GCI score remains stable between +5% and –5%
↘ GCI score changes by –5% to –15%
⇓ GCI score changes by < –15% to –20%

high inequality score of 39.5. On the environmental side, Japan attains a more mixed performance, doing well in terms of environmental policies (good commitment on regulation and standards), yet it continues to face high emissions.

The **United States** shows middling results in both social and environmental sustainability, which results in a slightly lower score in the sustainability-adjusted GCI than in the GCI itself. The country's social sustainability score is affected by increasing inequality and youth unemployment. However, it is the score in the environmental sustainability–adjusted GCI that is a concern for the country's sustainable prosperity. For example, the United States is among the countries that have ratified the fewest environmental treaties in the sample.

Mexico is an economy with somewhat weak sustainable competitiveness in both dimensions. On the social side, Mexico's performance is affected by high inequality and a large informal economy. Environmentally, Mexico is penalized for its high and increasing levels of emissions, relatively intense use of water for agriculture, and a perception that the natural environment is highly degraded.

Several other **Latin American** countries see a number of weaknesses in both pillars, with Argentina and the Dominican Republic encountering more concerns on the environmental side and Peru, Colombia, and Paraguay with more concerns in the social sustainability area.

Costa Rica, on the other hand, stands out for its positive environmental performance. Attaining a better result in the environmental sustainability–adjusted GCI than in the underlying GCI, the country could be a reference for the rest of Latin America. First of all, Costa Rica has low air pollution with levels of particulate matter ($PM_{2.5}$) and CO_2 among the lowest of the countries studied. The country is actively avoiding deforestation through one of the world's most extensive programs of rainforest conservation. One area of concern remains overfishing, which would be important to address given the importance of the fishing industry in the country.

Brazil performs slightly better in the overall environmental sustainability–adjusted GCI than in the social sustainability–adjusted GCI. However, Brazil's overall relatively good performance masks a number of environmental concerns—such as the deforestation of the Amazon—with the country displaying one of the highest rates of deforestation in the world. And although Brazil demonstrates an overall reasonable performance in the social sustainability area, the country's very high inequality remains an area of concern.

In general, outside of Brazil, the other three **BRICs** (Russia, India, and China) all reveal significant weaknesses in both dimensions of sustainable competitiveness.

The **Russian Federation** does particularly poorly in terms of environmental sustainability, with some of the poorest ratings globally for three indicators: the strength of environmental regulations, the number of international environmental treaties ratified by the country, and the quality of the natural environment.

India is the worst performer among the BRICs, with concerns in both areas of sustainability. On the social sustainability–adjusted GCI, India is not providing access to some basic services to many of its citizens (only 34 percent of the population has access to sanitation, for example). The employment of much of the population is also vulnerable, which—combined with weak official social safety nets—makes the country vulnerable to economic shocks. In addition, although no official data are reported for youth unemployment, numerous studies indicate that the percentage is very high. In terms of its environmentally sustainable competitiveness, India also has some areas of concern such as its high agricultural water intensity and significant air pollution.

China's competitiveness performance is notably weakened once the sustainability measures are taken into account, especially in terms of environmental sustainability. Although some political actions toward environmental improvement (such as afforestation) have been taken, the country continues to suffer from high emission levels (high levels of CO_2 and particulate matter) and the agricultural sector places a great deal of pressure on the environment (China's water intensity is very high). Social sustainability is only partially measured for China, as the country does not report data related to youth unemployment or vulnerable employment. However, the available indicators show a somewhat negative picture, with rising inequality and general access to basic services such as improved sanitation remaining low.

Among other economies analyzed in this section, **Turkey**—one of the countries that improved most in the GCI rankings this year—does not sustain its good performance once sustainability matters are taken into account. High inequality, vulnerable employment, and a large informal sector place pressure on the country's social sustainability. Similarly, high pollution and intensive water use for agriculture, as well as a lack of protected land area and a low commitment to international environmental agreements remain areas of concern for Turkey's environmentally sustainable competitiveness.

In contrast, **New Zealand,** with its strongly articulated political commitment to environmental stewardship, receives a positive assessment for its environmentally sustainable competitiveness. It also performs better than neighboring **Australia.** The main differences between the two countries lie in the lower level of air pollution in New Zealand and the country's efforts to set aside protected land areas. Both countries receive strong assessments for their social sustainability.

Box 5: Plea for better sustainability data

Data availability and quality are critical issues for both research and policymaking, and all projects concerned with assessing environmental or social conditions are limited by one or both of these concerns. These limitations make it difficult to track developments over time or to compare data across countries.

For example, datasets capturing some of the relevant areas of social sustainability—such as the International Labour Organization (ILO)'s Decent Work initiative (covering indicators such as injuries at work, excessive hours, and numbers of the working poor)—cover a limited number of countries. And some other indicators are not specific enough. For instance, including the indicator "CO_2 emissions to energy use" in the sustainability-adjusted GCI may give an idea of how efficiently economies are using fuels with respect to the associated emissions, but it also incorporates other factors (such as the industrial structure, the economic specialization, and the technology used in the country) that make it hard to isolate single elements and compare countries.

The available data concerned with the quality and use of water comprise another prominent example of data inadequacy. Although water has possibly one of the biggest environmental impacts on human life, researchers lack a globally agreed methodology for defining and measuring water scarcity and pollution, while data on water withdrawal—despite great efforts to maintain the Food and Agriculture Organization (FAO) Aquastat database—are not updated regularly. It is, however, precisely the timeliness of data updates for many of these indicators that is critical for policymakers. For some indicators it is indeed crucial. Youth unemployment, for instance, is changing relatively quickly in many economies, especially after an economic crisis. Yet several datasets on youth unemployment predate the crisis for some specific countries; using out-of-date figures could be misleading for policymakers, who need to have statistics that accurately reflect the actual current situation in order to gain a sense of the effectiveness of their reform efforts.

Data on social and environmental performances are particularly complex and intricate, and the challenges and the investments needed to produce sound indicators should not be underestimated. For instance, coming back to the point of the assessment of water pollution, it would be necessary to identify and agree on the list of substances and their relative levels that would define a water course as "polluted." Moreover, developing an aggregation methodology to turn local measurement into national statistics would be an important milestone. Such a methodology would help in understanding and monitoring issues that need to be managed to put economies on a more sustainable development path, and would provide statistical evidence to drive the agendas of policymakers.

In order to contribute to such data production and collection, the World Economic Forum has formed a Global Agenda Council on Measuring Sustainability. The Council aims to design and nurture one or more global public good initiatives to meet the needs of policymakers who must have access to high-quality, verifiable, and readily available contextually specific knowledge and information if they are to formulate responsible policies. Nonetheless, a wider international effort is required to overcome the challenge of measuring sustainability. This challenge can be met by pooling resources to produce and collect the data and by defining global measurement standards. The Global Agenda Council on Measuring Sustainability aims to participate in this effort by bringing scientists together while focusing the attention of policymakers on the need to develop new sustainability indicators.

CONCLUSIONS AND NEXT STEPS

Sustainable competitiveness is a nascent area of research and our initial work has shown that much of the data for measuring key concepts are not yet available. We therefore recognize that properly capturing the concept of sustainable competitiveness will require a multi-year effort. As more comprehensive and better data are needed to fully assess sustainable competitiveness, as noted above, there are a number of concepts we have not yet been able to capture (see Boxes 4 and 5).

However, by combining social and environmental indicators with the GCI we have been able to introduce the concept and carry out a preliminary analysis of national and regional social sustainability.

The main and very important finding is that there is no necessary trade-off between being competitive and being sustainable (by our definitions). On the contrary, many countries at the top of the competitiveness rankings are also the best performers in many areas of sustainability.

While creating value and being productive remain at the basis of economic development, the purpose of this work is to explore how social and environmental elements relate to economic progress and prosperity because the three areas are clearly interlinked. It is highly likely that sustained human progress and prosperity will depend on balancing economic progress with social inclusion and good and effective environmental stewardship.

The work presented in this chapter is the result of an ongoing process. We will update and refine our thinking over time, integrating feedback and the latest research on an ongoing basis. As we have already done over the past year, we will continue to carry out workshops and roundtables over the coming year in order to further refine the concept. We will also continue to seek better and more complete datasets in collaboration with the newly created World Economic Forum Global Agenda Council on Measuring Sustainability.

The Advisory Board on Sustainability and Competitiveness will continue to deliberate and to work with the Forum to integrate feedback collected into this

work. The goal is to present an even more complete measurement of the concept in time for the next *Global Competitiveness Report.*

Additionally, because—given its specific economic and political characteristics—the theme of sustainability requires a multi-stakeholder approach, the World Economic Forum will continue to serve the international community by providing a neutral platform on which to move ahead in this area. Work on sustainable competitiveness is one important component of this platform, and the Forum offers a space for conceptual discussion as well as assessment and analysis.

NOTES

1 See, for example, Atkinson 2003.

2 See, for example, Nordhaus 1994, 2000, 2002; Bovenberg and Smulders 1996; Aghion et al. 1998; and Acemoglu 2002, 2007, 2009.

3 See, for example, Perotti 1993: Bertola 1993: Alesina and Rodrik 1994: Persson and Tabellini 1994: and Green et al. 2006.

4 See the World Economic Forum 2012a for an assessment of how Europe is faring in meeting these goals.

5 For more information on this index, see www.oecdbetterlifeindex.org/.

6 See http://hdr.undp.org/en/.

7 For more information on the EPI, see http://www.epi.yale.edu/.

8 See http://www.footprintnetwork.org/en/index.php/GFN/page/methodology/ for information about information about the Global Footprint Network.

9 Information about the Global Adaptation Index is available at http://index.gain.org/.

10 The World Bank's *Worldwide Governance Indicators Framework* is available at http://info.worldbank.org/governance/wgi/index.asp.

11 Information about the Decent Work initiative is available at http://www.ilo.org/integration/themes/mdw/lang--en/index.htm.

12 See, for example, Marshal et al. 1997.

13 Smith 2012.

14 World Economic Forum. 2012b.

15 UN-HABITAT 2010.

16 Countries from the GCI sample were excluded if they were missing a maximum of two indicators considering both sustainability pillars.

17 See Acemoglu et al. 2012, for example.

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Appendix A: Calculation of the sustainability-adjusted GCI

As described in the text, the two areas of sustainability—social and environmental—are treated as independent adjustments to each country's performance in the Global Competitiveness Index (GCI). The adjustment is calculated according to the following steps.

AGGREGATION

In the first step, the individual indicators in each area are normalized on a 1-to-7 scale and aggregated by averaging the normalized scores, such that a social sustainability score and an environmental sustainability score are calculated for each country.

In the second step, these scores are normalized again on a 0.8-to-1.2 scale,[a] which is based on the distribution of each of the two sustainability components. The purpose of this methodology is to reward the countries attaining a relatively good performance on the two sustainability components while penalizing those that register a poor performance. Applying this methodology corresponds to transforming actual averages into coefficients ranging from 0.8 to 1.2. For example, the worst performer on the social sustainability pillar obtains a score of 0.8 and the best performer a 1.2. The same calculation is conducted for the environmental sustainability pillar.

Normalizing on a 0.8-to-1.2 scale and using the actual sample maximum and minimum are corroborated by the statistical distribution of the data, so as to ensure that the final data are not skewed. In the absence of empirical evidence, the selection of the impact limits (0.8–1.2) relies on the best judgment of the authors and is based on the assumption that countries can experience either an opportunity if they manage their resources well or a weakness if they do not.

The selection of this methodology is not intended to be scientific, but it represents a normative approach aimed at stimulating discussions on policy priorities and possibly stimulating scientific research in this field.

In the third step, the GCI score of each country is multiplied twice: once by its social sustainability coefficient and once by its environmental sustainability coefficient, to obtain two separate sustainability-adjusted GCI scores. Finally, an average of the two scores provides an overall measure of the sustainability adjustment.

STRUCTURE OF THE SUSTAINABILITY PILLARS

The computation of the sustainability components is based on an arithmetic mean aggregation of scores from the indicator level.[b]

Variables that are not derived from the Executive Opinion Survey (Survey) are identified by an asterisk (*) in the following pages. To make the aggregation possible, these variables are transformed into a 1-to-7 scale in order to align them with the Survey results. We apply a min-max transformation, which preserves the order of, and the relative distance between, country scores.[c]

Indicators marked with a "(log)" subscript are transformed applying the logarithm (base 10) to the raw score.

Social sustainability pillar

S01 Income Gini index*
S02 Youth unemployment*
S03.01 Access to sanitation*[d] $_{(log)}$
S03.02 Access to improved drinking water*[d]
S03.03 Access to healthcare[d]
S04 Social safety net protection
S05 Extent of informal economy
S06 Social mobility
S07 Vulnerable employment*

Environmental sustainability pillar

S08.01 Stringency of environmental regulation[e]
S08.02 Enforcement of environmental regulation[e]
S09 Terrestrial biome protection*
S10 No. of ratified international environmental treaties*
S11 Agricultural water intensity*
S12 CO_2 intensity*$_{(log)}$
S13 Fish stocks overexploited*$_{(log)}$
S14.01 Forest cover change*[f]
S14.02 Forest loss*[f] $_{(log)}$
S15 Particulate matter (2.5) concentration*$_{(log)}$
S16 Quality of the natural environment

NOTES

a Formally we have

$$0.4 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 0.8$$

The *sample minimum* and *sample maximum* are, respectively, the lowest and highest country scores in the sample of economies covered by the sustainability-adjusted GCI in each pillar.

b Formally, for a category *i* composed of *K* indicators, we have:

$$category_i = \frac{\sum_{k=1}^{K} indicator_k}{K}$$

c Formally, we have:

$$6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 1$$

The *sample minimum* and *sample maximum* are, respectively, the lowest and highest country scores in the sample of economies covered by the sustainability-adjusted GCI. In some instances, adjustments were made to account for extreme outliers. For those indicators for which a higher value indicates a worse outcome (e.g., CO_2 emission, income Gini index), the transformation formula takes the following form, thus ensuring that 1 and 7 still corresponds to the worst and best possible outcomes, best possible outcomes, respectively:

$$-6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 7$$

d Variables S03.01, S03.02, and S03.03 are combined to form one single variable.

e Variables S08.01 and S08.02 are combined to form one single variable.

f Variables S14.01 and S14.02 are combined to form one single variable.

Appendix B: Technical notes and sources for sustainability indicators

The data in this *Report* represent the best available estimates from various national authorities, international agencies, and private sources at the time the *Report* was prepared. It is possible that some data will have been revised or updated by the sources after publication. Throughout the *Report,* "n/a" denotes that the value is not available or that the available data are unreasonably outdated or do not come from a reliable source.
For each indicator, the title appears on the first line, preceded by its number to allow for quick reference. The numbering is the same as the one used in Appendix A. Below is a description of each indicator or, in the case of Executive Opinion Survey data, the full question and associated answers. If necessary, additional information is provided underneath.

S01 Income Gini index

Measure of income inequality [0 = perfect equality; 100 = perfect inequality] | 2010 or most recent year available

This indicator measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentage of total income received against the cumulative percentage of recipients, starting with the poorest individual. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while a value of 100 implies perfect inequality.

Source: The World Bank, *World Development Indicators Online* (retrieved June 1, 2012); CIA World Factbook (retrieved June 6, 2012); national sources

S02 Youth unemployment

Youth unemployment measured as the ratio of total unemployed youth to total labor force aged 15–24 | 2010 or most recent year available.

Youth unemployment refers to the share of the labor force aged 15–24 without work but available for and seeking employment.

Source: International Labour Organization, *Key Indicators of the Labour Markets Net* (retrieved June 5, 2012)

S03.01 Access to sanitation

Percent of total population with access to improved sanitation facilities | 2010 or most recent year available.

Percent of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained. A logarithm transformation is applied to the ratio of these statistics in order to spread the data distribution.

Source: World Health Organization, *World Health Statistics 2012* online database (retrieved June 5, 2012)

S03.02 Access to improved drinking water

Percent of total population with access to improved drinking water | 2010 or most recent year available

Percent of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, or rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. *Reasonable access* is defined as the availability of at least 20 liters per person per day from a source within 1 kilometer of the dwelling.

Source: World Health Organization, *World Health Statistics 2012* online database (retrieved June 5, 2012)

S03.03 Access to healthcare

How accessible is healthcare in your country? [1 = limited—only the privileged have access; 7 = universal—all citizens have access to healthcare] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions

S04 Social safety net protection

In your country, does a formal social safety net provide protection from economic insecurity due to job loss or disability? [1 = not at all; 7 = fully] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions

S05 Extent of informal economy

How much economic activity in your country would you estimate to be undeclared or unregistered? [1 = most economic activity is undeclared or unregistered; 7 = most economic activity is declared or registered] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions

S06 Social mobility

To what extent do individuals in your country have the opportunity to improve their economic situation through their personal efforts regardless of the socioeconomic status of their parents? [1 = little opportunity exists to improve one's economic situation; 7 = significant opportunity exists to improve one's economic situation]

Source: World Economic Forum, Executive Opinion Survey, 2012 edition

S07 Vulnerable employment

Proportion of own-account and contributing family workers in total employment | 2010 or most recent year available

Vulnerable employment refers to the proportion of unpaid contributing family workers and own-account workers in total employment. *Own-account workers* are those workers who, working on their own account or with one or more partners, hold the type of job defined as a self-employed job and have not engaged on a continuous basis any employees to work for them during the reference period. A *contributing family worker* is a person who holds a job in a market-oriented establishment operated by a related person living in the same household and who cannot be regarded as a partner because the degree of his or her commitment to the operation of the establishment, in terms of the working time or other factors to be determined by national circumstances, is not at a level comparable with that of the head of the establishment.

Source: The World Bank, *World Development Indicators Online* (retrieved June 1, 2012)

S08.01 Stringency of environmental regulation

How would you assess the stringency of your country's environmental regulations? [1 = very lax; 7 = among the world's most stringent] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions

S08.02 Enforcement of environmental regulation

How would you assess the enforcement of environmental regulations in your country? [1 = very lax; 7 = among the world's most rigorous] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions

S09 Terrestrial biome protection

Degree to which a country achieves the target of protecting 17 percent of each terrestrial biome within its borders | 2010 or most recent year available

This indicator is calculated by Columbia University's Center for International Earth Science Information Network (CIESIN) by overlaying the protected area mask on terrestrial biome data developed by the World Wildlife Fund (WWF)'s Terrestrial Eco-regions of the World for each country. A *biome* is defined as a major regional or global biotic community, such as a grassland or desert, characterized chiefly by the dominant forms of plant life and the prevailing climate. Scores are capped at 17 percent per biome such that higher levels of protection of some biomes cannot be used to offset lower levels of protection of other biomes, hence the maximum level of protection a country can achieve is 17 percent. CIESIN uses time series of the World Database on Protected Areas (WDPA) developed by the United Nations Environment Programme (UNEP) World Conservation Monitoring Centre (WCMC) in 2011, which provides a spatial time series of protected area coverage from 1990 to 2010. The WCMC considers all nationally designated protected areas whose location and extent is known. Boundaries were defined by polygons where available; where they were not available, protected-area centroids were buffered to create a circle in accordance with the protected area size. The WCMC removed all overlaps between different protected areas by dissolving the boundaries to create a protected areas mask.

Source: Yale University and Columbia University, Environmental Performance Index (EPI) 2012 edition, based on WWF World Wildlife Fund USA and UNEP WCMC data

S10 No. of ratified international environmental treaties

Total number of ratified environmental treaties | 2010

This indicator provides the total number of environmental treaties ratified by a country. It measures the total number of international treaties from a set of 25 for which a state is a participant. A state becomes a "participant" by Ratification, Formal confirmation, Accession, Acceptance, Definitive signature, Approval, Simplified procedure, Consent to be bound, Succession, and Provisional application (which are here grouped under the term *ratification,* for reasons of convenience). The treaties included are: the International Convention for the Regulation of Whaling, 1948 Washington; the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 London, as amended in 1962 and 1969; the Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971 Ramsar; the Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972 Paris; the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 London, Mexico City, Moscow, Washington; the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 Washington; the International Convention for the Prevention of Pollution from Ships (MARPOL) as modified by the Protocol of 1978, 1978 London; the Convention on the Conservation of Migratory Species of Wild Animals, 1979 Bonn; the United Nations Convention on the Law of the Sea, 1982 Montego Bay; the Convention on the Protection of the Ozone Layer, 1985 Vienna; the Protocol on Substances that Deplete the Ozone Layer, 1987 Montreal; the Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 Basel; the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 London; the United Nations Framework Convention on Climate Change, 1992 New York; the Convention on Biological Diversity, 1992 Rio de Janeiro; the International Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, particularly Africa, 1994 Paris; the Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, 1994 New York; the Agreement relating to the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995 New York; the Kyoto Protocol to the United Nations Framework Convention on the Climate Change, Kyoto 1997; the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998 Rotterdam; the Cartagena Protocol of Biosafety to the Convention on Biological Diversity, 2000 Montreal; the Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances, 2000 London; the Stockholm Convention on Persistent Organic Pollutants, 2001 Stockholm; the International Treaty on Plant Genetic Resources for Food and Agriculture, 2001 Rome; and the International Tropical Timber Agreement 206, 1994 Geneva.

Source: The International Union for Conservation of Nature (IUCN) Environmental Law Centre *ELIS Treaty Database*

S11 Agricultural water intensity

Agricultural water withdrawal as a percent of total renewable water resources | 2006 or most recent year available

Agricultural water withdrawal as a percent of total renewable water resources is calculated as: 100 × agricultural water withdrawal / total renewable water resources. In turn, total renewable = surface renewable water + renewable water resources groundwater – overlap between surface and groundwater. Where available, this indicator includes water resources coming from desalination used for agriculture (as in Kuwait, Saudi Arabia, the United Arab Emirates, Qatar, Bahrain, and Spain).

Source: FAO AQUASTAT database, available at http://www.fao.org/nr/water/aquastat/main/index.stm (retrieved May 31, 2012)

S12 CO_2 intensity

CO_2 intensity (kilograms of CO_2 per kilogram of oil equivalent energy use) | 2008

Carbon dioxide (CO_2) emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. *Energy use* refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. A logarithm transformation is applied to the ratio of these statistics in order to spread the data distribution.

Source: The World Bank, *World Development Indicators Online* (retrieved June 1, 2012)

S13 Fish stocks overexploited

Fraction of country's exclusive economic zone with overexploited and collapsed stocks | 2006

The Sea Around Us (SAU) project's Stock Status Plots (SSPs) are created in four steps (Kleisner and Pauly, 2011). The first step is to define a stock. SAU defines a stock to be a taxon (either at the species, genus, or family level of taxonomic assignment) that occurs in the catch records for at least 5 consecutive years, over a minimum of 10 years, and which has a total catch in an area of at least 1,000 tonnes over the time span. In the second step, SAU assesses the status of the stock for every year relative to the peak catch. SAU defines five states of stock status for a catch time series. This definition is assigned to every taxon meeting the definition of a stock for a particular spatial area considered (e.g., exclusive economic zones, or EEZs). Stock status states are: (1) Developing—before the year of peak catch and less than 50 percent of the peak catch; (2) Exploited—before or after the year of peak catch and more than 50 percent of the peak catch; (3) Overexploited—after the year of peak catch and less than 50 percent but more than 10 percent of the peak catch; (4) Collapsed—after the year of peak catch and less than 10 percent of the peak catch; (5) Rebuilding—occurs after the year of peak catch and after the stock has collapsed, when catch has recovered to between 10 and 50 percent of the peak. In the third step, SAU graphs the number of stocks by status by tallying the number of stocks in a particular state in a given year and presenting these as percentages. In the fourth step, the cumulative catch of stock by status in a given year is summed over all stocks and presented as a percentage in the catch by stock status graph. The combination of these two figures represents the complete Stock Status Plot. The numbers for this indicator are taken from the overexploited and collapsed numbers of stocks over total numbers of stocks per EEZ. A logarithm transformation is applied to these statistics in order to spread the data distribution.

Source: Yale University and Columbia University, Environmental Performance Index (EPI) 2012 edition based on Sea Around Us data

S14.01 Forest cover change

Percent change in forest area over the period 1990–10 | 2010

This measure represents the percent change in forest area, applying a 10 percent crown cover as the definition of forested areas, between time periods. We used total forest extent rather than the extent of primary forest only. The change measure is calculated from forest area data in 1995, 2000, 2005, and 2010. The data are reported by national governments, and therefore methods and data sources may vary from country to country. Positive values indicate afforestation or reforestation, and negative values represent deforestation.

Source: Yale University and Columbia University, Environmental Performance Index (EPI) 2012 edition based on Sea Around Us data

S14.02 Forest loss

Forest cover lost over the period 2000–10 based on satellite data | 2010

This indicator represents the loss of forest area owing to deforestation from either human or natural causes, such as forest fires. The University of Maryland researchers used Moderate Resolution Imaging Spectroradiometer (MODIS) 500-meter resolution satellite data to identify areas of forest disturbance, then used Landsat data to quantify the area of forest loss. This indicator uses a baseline forest cover layer (forest cover fraction with a 30 percent forest cover threshold) to measure the area under forest cover in the year 2000. It then combines forest loss estimates from Landsat for the periods 2000–05 and 2005–10 to arrive at a total forest cover change amount for the decade. This total is then divided by the forest area estimate for 2000 to come up with a percent change in forest cover over the decade. Further details on the methods used are found in Hansen, M., S. V. Stehman, and P. V. Potapov. 2010. "Quantification of Global Gross Forest Cover Loss." *Proceedings of the National Academies of Science,* available at www.pnas.org/cgi/doi/10.1073/pnas.0912668107. A logarithm transformation is applied to these statistics in order to spread the data distribution.

Source: Yale University and Columbia University, Environmental Performance Index (EPI) 2012 edition, based on University of Maryland data

S15 Particulate matter (2.5) concentration

Population-weighted exposure to $PM_{2.5}$ in micrograms per cubic meter, based on satellite data | 2009

This indicator was developed by the Battelle Memorial Institute in collaboration with Columbia University's Center for International Earth Science Information Network (CIESIN) and funding from the NASA Applied Sciences Program. Using relationships between the Moderate Resolution Imaging Spectroradiometer (MODIS) Aerosol Optical Depth (AOD) and surface $PM_{2.5}$ concentrations that were modeled by van Donkelaar et al. (2010), annual average MODIS AOD retrievals were used to estimate surface $PM_{2.5}$ concentrations from 2001 to 2010. These were averaged into three-year moving averages from 2002 to 2009 to generate global grids of $PM_{2.5}$ concentrations. The grids were resampled to match CIESIN's Global Rural-Urban Mapping Project (GRUMP) 1 kilometer population grid. The population-weighted average of the $PM_{2.5}$ values were used to calculate the country's annual average exposure to $PM_{2.5}$ in micrograms per cubic meter. A logarithm transformation is applied to these statistics in order to spread the data distribution.

Source: Yale University and Columbia University, Environmental Performance Index (EPI) 2012 edition based on NASA MODIS and MISR data (van Donkelaar et al. [2010]), Battelle, and CIESIN

S16 Quality of the natural environment

How would you assess the quality of the natural environment in your country? [1 = extremely poor; 7 = among the world's most pristine] | 2011–12 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2011 and 2012 editions