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CHAPTER 1.2

Assessing the Sustainable Competitiveness of Nations

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The concept of competitiveness aims at capturing the economic development process as a necessary condition for improved living standards. During most of the post–World War II period, economic growth was accompanied by an improvement in living conditions for large parts of the world's population. More recently, toward the end of the last century, economic growth in developing and emerging markets has helped millions of people escape poverty.

Recent projections and studies point out that the rates of progress seen in the past may not be sustainable going forward.[1] As income levels have risen and more and more emerging markets have entered rapid growth paths, pressures on the environment have become more palpable and concerns over the distribution of the benefits of economic progress within countries have grown. This has led many to question whether the prevalent growth model is sustainable over time.

The perception that economic growth is not translating into the desired results for society at large was given further support by the recent financial crisis and the ensuing economic slowdown, which brought social tensions to light. These manifested themselves in multiple ways, including the events related to 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. Diminishing economic prospects, sometimes combined with demand for more political participation, have also sparked protests in several countries including, for example, the recent events in Brazil and Turkey.

At the same time, pressures on the natural environment resulting from economic activity have grown over recent decades. Pollution has increased and the loss of biodiversity is more and more problematic, while climate change and its unpredictable consequences raise concerns. The world is also facing a progressive scarcity of water, energy, and mineral resources, for which demand continues to climb. Despite some efforts to address these issues, the undesirable environmental consequences of human activity are leading to a less habitable world.

As a result, social and environmental sustainability increasingly influence economic policy decisions and can have an impact on economic performance. At the same time, these challenges bring into question whether well-established ideas and models that take a narrow view of economic growth and do not take into account the use of natural resources or social concerns can still provide adequate solutions. The relationships between these challenges need to be better understood and measured in order to inform policies that will set and achieve the desired objectives, and in order to better track progress toward higher levels of sustainable prosperity.

Box 1: Public-private collaboration to achieve sustainable competitiveness

The World Economic Forum is taking an important step forward to inform the discussion on competitiveness by creating a Competitiveness Repository. This new initiative aims at bridging a knowledge gap in the current literature by compiling relevant information about the content and process of building public-private collaboration practices that have improved competitiveness.

Public private collaborations have also been used to reinforce environmental and social sustainability over the last 20 years to achieve enduring results. For example, areas such as health and education—two crucial pillars of competitiveness and also of social sustainability—have long been areas of multi-stakeholder collaboration. As early as 1993, the World Health Organization recognized that achieving health for all would require partnerships with the private sector and civil society, and subsequently made such partnerships part of the organization's strategy.[1] Nowadays, most international organizations systematically include the private sector in their strategies. This approach was evident at the latest United Nations Conference on Sustainable Development, where heads of state recognized that "[Sustainable Development] can only be achieved with a broad alliance of people, governments, civil society and the private sector, all working together to secure the future we want for present and future generations."[2]

Achieving sustainable competitiveness requires funding and expertise that cannot come from the public sector alone—especially in the context of cash-strapped governments and austerity measures. Involving the private sector in a collaborative way (through shared visions and deep engagement in planning and decision making) can have many benefits:

1. Typically, the most obvious reason for involving the private sector in environmental and social sustainability national projects has been **financial:** it is a way for governments to add investment to underfunded projects in public infrastructure and services. For instance, the Green Growth Action Alliance is a group that supports the scaling-up in green infrastructure investment through the collaboration of more than 50 leading financial institutions, corporations, governments, and nongovernmental organizations.[3] In Vietnam, the Alliance will support the government's efforts to transform the country's agricultural sector with the goal of delivering a 20 percent reduction in emissions, a 20 percent reduction in poverty, and a 20 percent increase in growth.
2. In some sectors of the economy, initiatives can also greatly benefit from the **skills and expertise of the private sector,** which the public sector may lack. For instance, in the context of water management (which, beyond being an infrastructure matter, also has a strong social and environmental impact), the responsibility of providing water often rests solely with the Ministry of Agriculture or a similar department. However, key industries—such as food and beverage, mining and metals, and energy—have developed skills and expertise that can be used to ensure a more equitable and sustainable use of water resources. The Water Resource Group is an example of an innovative public-private platform for collaboration that mobilizes stakeholders from the public and private sectors, civil society, centers of academic expertise, and financing institutions to help governments manage the water sector sustainably in support of their economic growth plans.[4] In South Africa, the Water Resource Group has led to improvement in

(Cont'd.)

COMPETITIVENESS AND SUSTAINABILITY

The relationship between some aspects of sustainability and economic growth has been studied extensively by academics, policy practitioners, and international organizations.[2] Public interest in sustainable development has also increased over the past few decades, driven by influential work such as the report *Our Common Future,* which was published under the auspices of the United Nations by the Brundtland Commission in 1987. In this seminal report, sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[3] The breadth of the definition was meant to capture the several dimensions of development that go beyond the usual boundaries of economic growth in order to include both the tangible and intangible necessities of life. This initial concept mainly focused on environmental aspects of development. However, it has evolved significantly over time and today it is widely accepted that sustainability also includes an economic and a social dimension.

Despite mounting interest in sustainable development, the relationship between environmental or social sustainability and national competitiveness has been only marginally explored. So far, economists have devoted most of their efforts to trying to understand the way economic growth impacts the quality of the environment or income distribution within a country and vice versa. However, little is known about how these aspects of sustainability relate to competitiveness and productivity.

Against this background, the World Economic Forum has engaged in a series of activities to expand our knowledge about sustainability and its relationship to competitiveness. More precisely, the Forum has been at the forefront of the discussion on environmental sustainability, working to shape the agenda by catalyzing public-private platforms that help governments draw on private-sector expertise to identify and implement

Box 1: Public-private collaboration to achieve sustainable competitiveness *(cont'd.)*

effluent and wastewater management, water efficiency and leakage reduction, and agriculture and supply chains.

3. Public-private collaboration might also allow the public sector to **reach remote communities**. A recent paper from the International Institute for Sustainable Development highlights the importance of public-private collaboration for sustainable development. Indeed, the private sector's involvement can help "deliver a range of essential public services to even the most remote areas and marginalized communities."[5] For instance, in Nepal the Public Private Partnership for Urban Environment (PPUE)[6]—a collaboration among the Federation of Nepalese Chambers of Commerce & Industry, the Municipal Association of Nepal, the United Nations Development Programme, and the Asian Development Bank—aims to boost the coverage and quality of basic urban services to the urban poor while increasing the participation of the local population in the process of service delivery. The project has already supported its partner municipalities to implement 88 projects that demonstrate this way of providing services and developing infrastructure. In 2010 and 2011, most of the projects were in solid waste management, mobile toilets, sewage-attached biogas, solar street lighting, the management of recreational areas and city markets, and building and operating slaughterhouses. Most of these initiatives are improving the urban environment and services for urban dwellers as well as providing new employment for local residents by hiring them for the new projects.
4. Finally, and very importantly, public-private collaboration may contribute to **long-term acceptance,** especially in the context of environmental regulations. Indeed, by studying a series of examples, researchers from Harvard University's Kennedy School came to the conclusion that regulations on environmental policies that are negotiated with industries and citizens are more likely to be successful in the long term.[7]

The Competitiveness Repository will continue to highlight cases of public-private collaboration in the domain of social and environmental sustainability and bring them into the multi-stakeholder discussions that the World Economic Forum regularly organizes at global and regional summits and at targeted roundtables. The purpose of these discussions is to catalyze action and commitment from different stakeholders.

Notes

1 Buse and Waxman 2001.

2 United Nations Sustainable Development Knowledge Platform. Future We Want: Outcome document, I. Our common vision, Item 13. Available at http://sustainabledevelopment.un.org/futurewewant.html.

3 For more information about the Green Growth Action Alliance, see www.weforum.org/issues/climate-change-and-green-growth.

4 For further information about the 2030 Water Resources Group, see www.2030wrg.org.

5 Colverson and Perera 2012, p. 21.

6 For information about the organization Public-Private Partnerships for Urban Environment, see www.pppue.org.np.

7 Pande et al. 2012.

solutions to the most pressing issues. As a key convening platform for the international community, national policymakers, and business leaders, the World Economic Forum has found itself at the center of the discussion on the nature of the relationship between competitiveness and sustainability. Issues of economic, social, and environmental sustainability have been showcased and discussed at many of the Forum's regional and annual meetings and, more recently, the Forum has embarked on a new initiative to identify and showcase public-private collaborations that can support sustainable competitiveness, as described in Box 1.

In addition, the World Economic Forum—in collaboration with a multi-stakeholder Advisory Board of international experts (Box 2)—embarked on an effort to integrate the concept of sustainability into its competitiveness work. The results of our preliminary work were released in last two editions of *The Global Competitiveness Report.*

In this edition, we continue our ongoing efforts to build a more robust narrative of the concept of sustainable competitiveness. These efforts aim to better understand the complex relationship between competitiveness and sustainability and to provide a working definition of the concept, thereby contributing to the intellectual debate. The chapter also updates the results for the preliminary measurement of sustainable competitiveness, the sustainability-adjusted Global Competitiveness Index, which was introduced for discussion in last year's edition of this *Report.*

The sections that follow explore the relationships among competitiveness, environmental sustainability, and social sustainability. The discussion will provide the building blocks to explain how we have arrived at the overall definition of *sustainable competitiveness,* which is *the set of institutions, policies and factors that make a nation remain productive over the longer term while ensuring social and environmental sustainability.*

Box 2: Consultation with external experts

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

The members of the Advisory Board are:

James Cameron, Chairman, Climate Change Capital, United Kingdom

Dan Esty, Commissioner, Connecticut Department of Energy and Environmental Protection, USA

Clément Gignac, Chief Economist and Senior Vice-President, Industrial Alliance Insurance and Financial Services, 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), Switzerland

Two new members joined the Advisory Board in the course of the past year:

Lindene Patton, Chief Climate Product Officer, Zurich Insurance Group, Ltd., Switzerland

Anthony O'Sullivan, Head Private Sector Development, Organisation for Economic Co-operation and Development (OECD), France

In addition to frequent consultations with the Advisory Board (including a face-to-face meeting in Dubai in November 2012 during the Summit on the Global Agenda), The Global Competitiveness and Benchmarking Network team regularly consults with international experts in order to ensure that our work on sustainable competitiveness remains at the forefront of the research in this domain. Accordingly, in the last 18 months, three workshops were organized to:

1. Define sustainable competitiveness and review the rationale for the social pillar. This workshop was held in Geneva in April 2012 with experts from the World Health Organization, the United Nations Economic Commission for Europe, the International Labour Organization, and the International Organization for Migration.
2. Review the concept of environmental sustainability and discuss how it can be measured in our context. This workshop was held in New York in September 2012 with experts from the Center for International Earth Science Information Network at Columbia University, the United Nations Sustainable Development Department, the World Bank, and Zurich Insurance.
3. Discuss the impact that social and environmental sustainability have on one another. This workshop was held in Geneva in April 2013 with experts from the World Health Organization, the International Labour Organization, the United Nations Development Programme, the United Nations Environment Programme, the United Nations Research Institute for Social Development, the Overseas Development Institute, the Organisation for Economic Co-operation and Development, Deloitte, and KPMG.

In the upcoming year, The Global Competitiveness and Benchmarking Network team will hold further multi-stakeholder consultations in order to strengthen the relevance of the Sustainable Competiveness Project.

Competitiveness and environmental sustainability

For decades, economists, strategists, and business leaders were skeptical about the compatibility between environmental goals and industrial competitiveness.[4] In most of the macroeconomic literature,[5] nature has traditionally been regarded as a constraint. Because natural resources on the planet are either limited or they renew at a specific physical rate, they are usually viewed as a major source of "limits to growth."[6] Consequently, natural resources are modeled as an additional input in the production process or as an additional cost that must be incurred to abate unwanted byproducts such as pollution. Another limitation to growth, according to this strand of literature, can be traced back to nature's decreasing ability to dissipate waste from production as pollution accumulates. Once pollution reaches a critical limit, ecosystems will not be able to function properly and cannot absorb additional waste from production.

Although environmental limitations to growth are important, empirical evidence of development dynamics shows that the state of the environment tends to worsen at the initial stages of industrialization but to then improve as income increases—a concept known in the literature as the *Environmental Kuznets Curve.*[7] Many advanced

economies have adopted pollution control measures that have improved the state of the natural environment, yet this should not lead to the conclusion that environmental sustainability will be automatically achieved at a certain income level.[8] In order to preserve future generations' ability to benefit from nature's resources and services and increase standards of living, policies and measures that ensure an efficient use of natural resources as well as the adoption of clean industrial processes are significant.[9]

Taking into account all aspects described above, it emerges that the relationship between environmental sustainability and competitiveness is multifaceted and affects an economy in different ways. Multiple channels support a positive relationship between environmentally sustainable practices and productivity gains. Here we identify and describe the main ones:

- **Efficient use of natural resources.** The efficient use of natural resources includes both managing exhaustible raw materials and using renewable resources within their regenerative capacity in order to minimize production costs, ensure the legacy for future generations, and reduce pollution. As described by the literature on public goods, welfare increases once the negative externality generated by pollution is corrected.[10] It follows that environmental sustainability can bring about a better economic outcome if it is associated with formal or informal institutions that define property rights and result in the adoption of sustainable processes over the use of scarce resources.
- **Improved health.** A high-quality natural environment improves the productivity of the workforce by reducing health damage caused by pollution or environmental degradation. According to some studies,[11] in the Asia Pacific region alone about 2.5 million people die every year because of air pollution, unsafe water, and poor sanitation, creating a vicious circle of poverty, low-quality environmental conditions, and dismal economic performance. Since health affects productivity and pollution affects health, efforts to reduce pollution may be interpreted as an investment in human capital. Recent empirical evidence has indicated that, in the United States, ozone levels below federal air quality standards have a positive impact on productivity (a 10 parts per billion decrease in ozone concentrations raises worker productivity by 4.2 percent).[12] Finally, environment-driven health problems lead to resource misallocation, forcing governments to fund additional, and otherwise unnecessary, health programs and diverting resources that would otherwise go into productivity-enhancing investments in, for example, education or innovation.
- **Biodiversity for innovation.** Ultimately, environmental degradation can impact the way ecosystems work and reduce biodiversity. Biodiversity supports the productivity of the workforce by providing food, fiber, shelter, and natural medicines, and it regulates the water supply and air quality. According to the Convention on Biodiversity,[13] more than 1.3 billion people in the world depend on biodiversity and on basic ecosystem goods for their livelihoods. Biodiversity losses caused by deforestation or significant land-use changes—which today are estimated to be 100 to 1,000 times greater than is considered to occur naturally—increase the vulnerability of terrestrial and aquatic ecosystems and induce changes in climate and ocean acidity.[14] Biodiversity is also a key driver of economic growth, especially in developing countries, because it provides the basis for many innovations in areas such as pharmaceutical or cosmetic products. At the same time, interfering with ecosystems may make living conditions for humans more difficult and perhaps engender additional costs. Last but not least, biodiversity restoration and protection can create profitable business opportunities, incentivizing the development of new technologies and products for their utilization, in still-unexplored markets.[15]

In addition to these general sources of potential competitiveness gains for an economy, environmental sustainability can have more marked impacts in particular economic sectors such as agriculture,[16] fishery, and forestry. More precisely, in the absence of any technological change, a reduction in the cultivable area for staple crops would lead to a decrease in overall production, an increase in the price of staples, a fall in consumption, and widespread malnutrition. According to United Nations Environment Programme (UNEP)'s *Green Economy Report,* green agriculture is capable of nourishing a growing world population at higher nutritional levels, switching from today's 2,800 Kcal availability per-person per-day to around 3,200 Kcal by 2050. Furthermore, investing in the greening of tourism can reduce the cost of energy, water, and waste and thus enhance the value of biodiversity, ecosystems, and cultural heritage.[17] A degraded environment would reduce tourist inflows, which increasingly depend on the quality of a country's environment.[18]

Finally, human activities that are respectful of the environment help to reduce the likelihood of extreme weather events such as floods, windstorms, and droughts. Natural disasters negatively affect the competitiveness of an economy by impacting the life and health of the local workforce and by diverting available resources from productivity-enhancing investments, such as education or innovation, for rescue and

reconstruction purposes. At the same time, disasters destroy tangible assets such as infrastructure, public facilities, and industrial stocks, and they interrupt the regular flows of goods and services both within and between countries. 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 more a hostile climate will amount to approximately US$85 billion per year. An example is the unprecedented floods in Thailand in 2011, which, according to the World Bank, cost its economy US$45 billion and triggered the disruption of many global supply chains.[19] Also in 2011, China experienced its worst drought in 50 years, with over 4 million farmers facing severe water shortages. And recent floods in the Philippines have claimed at least 1,500 lives, with corresponding negative impacts to infrastructure and land.

In terms of empirical evidence, a body of research supporting the positive relationship between competitiveness and environmental sustainability is slowly emerging. Jaffe and Palmer (1997) suggest a positive relationship between the intensity of environmental regulation and innovation as measured by the amount of R&D expenditure,[20] which contributes to productivity, at a country level. In the *Green Economy Report,*[21] the UNEP argues that a green economy, which invests a considerable amount of resources in the preservation of the environment and in the restoration of natural capital, tends to grow faster than a brown economy, which underinvests in natural capital and overinvests in activities that cause its degradation. Moreover, over the longer term, the green growth path starts off lower than the brown one but eventually surpasses it, when environmental damage begins to constrain growth. In this context, green growth leads to higher energy and resource efficiency, reduces greenhouse gas emissions, enhances ecosystem services, and creates additional jobs in the medium term.

At the firm level, the impact of environmental standards on productivity has become more and more controversial. Some recent studies suggest that the relationship between higher environmental standards and productivity could be positive, contrary to the traditional analysis that finds this relationship to be negative. For instance, refineries in the Los Angeles area of California, where environmental regulation tended to be stricter than in other US states, have enjoyed higher productivity than refineries located elsewhere in the country. Other studies on the Mexican food-processing industry have found that productivity is positively correlated with the intensity of environmental regulation.[22]

Based on the analysis and the relationship between different elements of environmental sustainability and competitiveness, we define *environmentally sustainable competitiveness* as *the institutions, policies, and factors that ensure an efficient management of resources to enable prosperity for present and future generations.*

Competitiveness and social sustainability

The body of research on social sustainability is growing, but remains limited. Because of the sometimes intangible nature of the social dimension of growth that is often the result of deliberate political choice, the concept of social sustainability tends to be under-theorized.[23] The social dimension of development, which had been considered in works such as the recommendations from the Stiglitz-Sen-Fitoussi Commission and by the *Brundtland Report,* has only recently gained greater recognition both in academic and policymaking circles.

Overall, there is no widely accepted definition of social sustainability. Each branch of social science tends to approach it from a different perspective, applying different criteria. However, it is possible to identify recurring themes in the different definitions that have been proposed so far. Human rights, equity, and social justice are among the most relevant.

Both the theoretical underpinnings of the relationship between social sustainability and development and empirical evidence to support such a theory remain somewhat unclear, although a series of recent events in different parts of the world seems to suggest that an unbalanced social model can undermine the stability of the growth process for both current and future generations. The recent wave of protests in Brazil, the several chapters of social revolts in the Arab World, and the Occupy Wall-Street Movement in the United States are some examples of how, if economic benefits are perceived to be unevenly redistributed within a society, riots or social discontent can affect the capacity of individuals to contribute to and benefit from higher rates of economic growth.

In what follows, we will individually analyze those dimensions of social sustainability that are likely to fuel productivity and long-term prosperity while at the same time preserving social stability. Our aim is to unbundle the most relevant elements, even if they are often interrelated and not always clearly distinct:

- **Inclusion.** An inclusive social system ensures that all citizens contribute to and benefit from the economic prosperity of their country. Inclusion is a prerequisite for social cohesion because, if some members of the community are marginalized, the society will lack the necessary coherence of goals to accomplish common purposes. Typical examples of social exclusion that have a considerable negative impact on the competitiveness of a nation are the lack of access to basic necessities, discrimination according to gender, youth marginalization, and extreme polarization of income. Any type of social exclusion that prevents people from

fully participating in the labor market reduces the availability of talent to a country's firms and organizations, thereby reducing competitiveness. Lack of access to sanitation, drinkable water, or healthcare can dramatically impair labor productivity, reducing the ability of the economy to compete globally. At the same time, when young people are marginalized by the labor market and have access only to short-term and highly volatile jobs, they remain vulnerable, especially during downturns. These workers usually receive less on-the-job training than their counterparts in stable positions, with a reduction in the overall level of human capital. Finally, the participation and empowerment of women is key to ensuring a large talent pool and tends to bring about other positive effects, such as reducing infant mortality, reducing poverty, improving the management of scarce resources, reducing conflict, and guaranteeing food security.[24]

- **Equity and cohesion.** An equitable society guarantees the same opportunities to its members, rewarding them according to their talents and fairly redistributing the benefits of growing wealth,[25] creating a cohesive society with no excessive income disparities across different groups. Inequality is a multidimensional concept. For the purposes of this *Report* we are mainly interested in income inequality, which certainly represents one of the biggest challenges for policymakers globally and which is highly correlated with access to other opportunities. According to the literature,[26] some of the main arguments suggesting that inequality may be harmful for growth are, first, that it can potentially distort the political process; second, it could suppress aggregate demand; third, it requires more redistributive efforts, thus potentially introducing more market distortions; and, finally, it may trigger economically harmful social tensions, especially in the context of a weak institutional setup. Persistent inequalities tend to limit upward social mobility, preventing gifted and hard-working individuals from being rewarded according to their talents. However, it can be argued that some degree of disparity—provided it is not driven by rent positions—is actually beneficial for growth because it incentivizes people to invest in education, work harder, and be more innovative and productive.

- **Resilience.** A social system is resilient when it can absorb temporary or permanent shocks and adapt to quickly changing conditions without compromising its stability. Formal or informal institutions usually perform the role of shock absorber, reducing the vulnerability of the society as a whole. In advanced economies, welfare states promote the economic and social well-being of the society by protecting its members from excessive loss of income during old age and during periods of unemployment or illness. Although welfare systems represent a source of stability for the economy, they can turn into a hurdle for its competitiveness since overly generous social security programs increase labor costs, can undermine the stability of public finances and limit macro-stabilization policies, and can hamper the incentives to work, innovate, and excel. In order to be sustainable, a social protection system needs to be well balanced and affordable.

  The resilience of a social system also depends on the features of its labor market and on the extent of the black economy. When workers have access only to short-term contracts or vulnerable employment, they are exposed to negative shocks and to all the costs associated with unemployment. Moreover, a widespread black economy may affect the resilience of a social system, since informal workers are more vulnerable to concerns related to job loss, old age, maternity, disability, or illness.

Based on the above 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.*

Relationship between environmental and social sustainability

The third and final relationship we would like to explore is the one between environmental and social sustainability. The quality of the environment and the structure of a society are strictly correlated. On the one hand, well-managed natural resources increase the quality of life, reduce tensions within and between generations, provide better opportunities to the whole community, and improve the resilience of the society. Moreover, the management of natural resources might translate into "in-kind" income distribution, as resource scarcity may leave the poorest of the population unable to access basic necessities. On the other hand, widespread prosperity, which facilitates a high quality of life, requires a functioning economy that, by definition, uses natural resources. For this reason, although the academic literature tends to focus on these two dimensions individually, the World Economic Forum is interested in exploring the way environmental and social sustainability interact with one another. In this chapter, we focus on selected channels that have been extensively highlighted by the literature:

- **Health and environmental degradation.** As discussed in the previous section, a degraded environment negatively affects the health, and thus the productivity, of the workforce. It also reduces

the overall quality of life of members of the society. Each year, air pollution, unsafe drinking water, and exposure to chemical products contribute to a number of often-lethal diseases both in the developed and developing world. According to the Organisation for Economic Co-operation and Development (OECD),[27] unsafe water supplies, lack of sanitation, and poor hygiene are responsible for 3 percent of all deaths worldwide, of which 90 percent are children. An unhealthy environment dampens economic opportunities, prevents people from participating in the life of the community, diverts resources from productive uses, and contributes to urban decline.

- **Demography, poverty, and the environment.** The relationship between demography and environmental/social sustainability is extremely intricate. Rapidly growing populations might be a source of environmental stress, leading to greenhouse gas emissions, high rates of soil erosion, and the extinction of species. If rapid population growth is not accompanied by environmental management, it can give rise to tensions between groups for the control of scarce resources and can therefore be a source of further social instability, creating a vicious circle. Persistent poverty may also affect the environment and may lead to massive unplanned urbanization, such as slums, where large segments of the population are without access to basic services. Such living conditions can have significant repercussions on the environment, including damage via deforestation and the pollution of water resources as a result of a lack of waste management.

- **Energy and social stability.** The consumption of carbon-based fuel is one of the major causes of global warming. According to the International Energy Agency,[28] in order to limit the rise of global temperature to 2°C, a number of measures need to be adopted to limit greenhouse gas emissions; these measures would consequently reduce the demand and therefore also the price of oil and gas. A study by HSBC estimates that a drop in demand of fossil fuel could cause the price of oil to remain below US$50 per barrel.[29] This would mean that only a third of current fossil fuel reserves would be burned before 2050 because the cost of extraction would overweigh the associated value. Reduced volumes and lower values for fossil fuel would impact the stock value of extractive companies and tax revenues from fossil fuel–related levies. Consequently, public revenues would be reduced, putting pressure on the affordability of several social programs. For energy-driven countries, a stark reduction in revenues from mineral resources may pose particular challenges to their welfare systems.

  An additional link between energy, environment, and social sustainability is the use of alternative energy sources, such as ethanol and biodiesel. Although these energy sources help to reduce CO_2 emissions, they also use wide land areas, contributing to the increase in food prices that led to a food crisis in 2008. Moreover, these alternatives also have significant environmental impact in the form of additional pressure on water resources, for example.[30]

- **Climate change, food security and conflict.**[31] In the future, rising sea levels and more extreme weather conditions may force millions of people to migrate, adding pressure on the use of natural resources—especially water—in the destination areas. Rising competition over these resources could eventually result in military conflict. Adverse changes in temperature and precipitation are likely to influence the capacity of many areas to produce food, thus increasing the vulnerability of the population. According to some studies, at present 1.7 billion people live in water-stressed countries. Industrialization and demographic forces are likely to further aggravate the situation, and climate change may exacerbate the situation even more by decreasing stream-flow and groundwater recharge.

  Pressure on water resources and land, combined with a growing world population and rising poverty in some regions, may also aggravate food security concerns, which already represent a major problem today.[32] At present, in the developing world there are at least 800 million individuals without sufficient access to food. In less-developed countries, decreasing crop yields may lead to further exploiting degraded land, while globally, changing environmental conditions are reducing crop productivity. This constellation of pressures may increase food insecurity in the long term, even in areas where food availability is relatively secure today.

- **Climate change and women's empowerment.**[33] According to a growing body of research, climate change is not gender neutral. In many rural and traditional societies in Africa, women are responsible for securing water, food, and energy for cooking and heating. But the effects of climate change such as droughts, heat waves, infections encouraged by rising temperatures, deforestation, and uncertain rainfall make it harder for these women to secure the resources they need. This, in turn, further weakens their position in society and reduces opportunities to better their lives and that of their families.

DEFINITION OF SUSTAINABLE COMPETITIVENESS

Given all these forces and interrelationships, and as already mentioned at the beginning of the chapter, we define *sustainable competitiveness* as *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, although 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 well-being to include other important elements that render societies sustainably prosperous 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 grow over the medium and long term, but whether the national development process is producing the kind of society in which we want to live.

THE MEASUREMENT OF SUSTAINABLE COMPETITIVENESS

In order to assess where we stand today and to provide meaningful insights about how we want to proceed on these inter-related issues, we need to be able to measure sustainability. The following sections lay out the key existing approaches to measuring sustainability and describe the methodology of the sustainability-adjusted Global Competitiveness Index, which is the World Economic Forum's ongoing contribution to these efforts.

Efforts to measure sustainability

Over recent decades, significant efforts have been made 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, was a major attempt at expanding 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 2009 also reflects a remarkable attempt to expand the measurement of prosperity in societies "beyond measures of market activity to measure wellbeing." 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."[34] The OECD is undertaking the Better Life Initiative, measured by the Better Life Index,[35] which includes social and environmental sustainability metrics; and, finally, the United Nations Development Programme (UNDP) has also included the concepts of environmental sustainability and equity in its human development assessment.[36]

All these efforts to better integrate environmental and social sustainability metrics 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, the Environmental Performance Index (EPI) and its predecessor the Environmental Sustainability Index, developed by researchers at Yale and Columbia universities;[37] the Ecological Footprint,[38] developed by the Global Footprint Network; and the Global Adaptation Index,[39] 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 are the World Bank's *Worldwide Governance Indicators Framework,* which measures different aspects of governance such as political instability, voice, and accountability;[40] and the International Labour Organization's Decent Work initiative, which aims at measuring various elements relevant for labor conditions.[41]

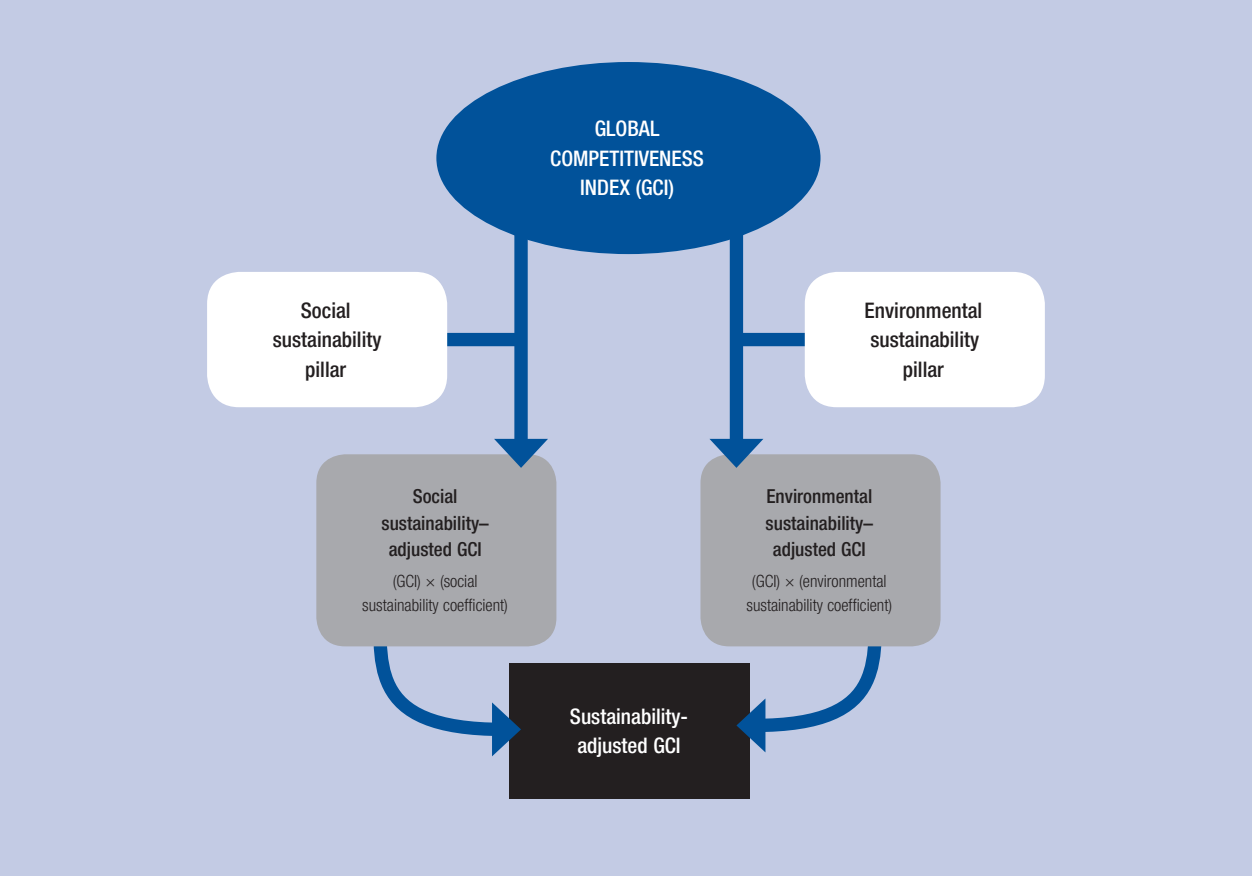
Despite this progress, a generalized lack of high-quality data that would allow countries to fully understand how they fare in these critical areas persists. Without an improvement in the quality and availability of key data on social and environmental sustainability, countries will continue to have trouble assessing the situation and monitoring their evolution in key dimensions. It will therefore be difficult for them to determine and implement appropriate policies and measures to ensure that their development model leads to the desired outcomes.

Sustainable competitiveness: The analytical 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

Figure 1: The structure of the sustainability-adjusted GCI



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

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 as well as a rich literature on growth and development.

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

As described in the first half 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 complex tasks from both a conceptual and a measurement point of view. Sufficient evidence does not yet exist that would lead to a solid 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 Competitiveness Index is an average of the two sustainability-adjusted indexes: the social sustainability–adjusted GCI and the environmental sustainability–adjusted GCI.[42]

Social sustainability pillar

For **social sustainability,** the Forum identifies three conceptual elements (Figure 2). The first category aims to assess a *population's access to basic necessities.*[43] 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 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.*

Figure 2: Summary of indicators for social sustainability

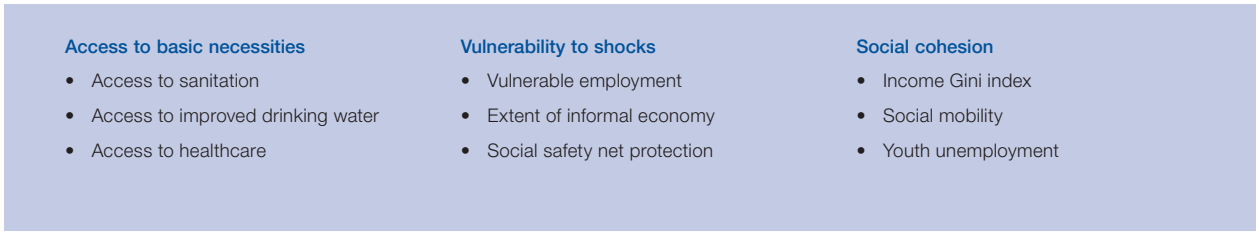
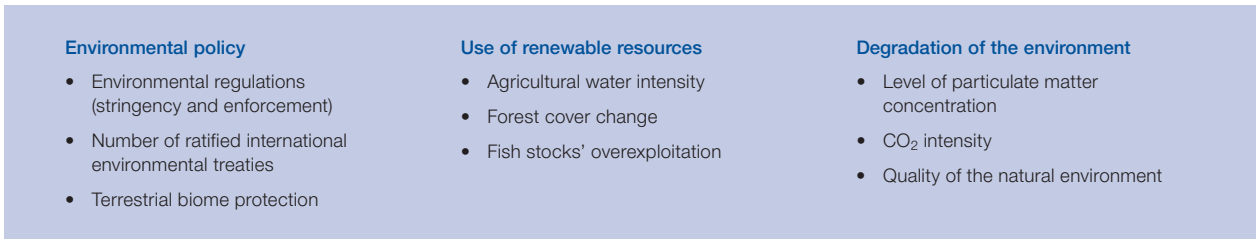


Figure 3: Summary of indicators for environmental sustainability



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 residence 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 helps households to maintain their access to basic needs 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, which can in turn translate into the creation of new jobs and innovative ideas, thus benefitting the economy.

A third category can be thought of as an assessment of *social cohesion* including the following indicators: the *Income Gini index, Social mobility,* and *Youth unemployment.* We include the income Gini index as a measure of income inequality, 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, we include an indicator on social mobility, which was introduced last year into the World Economic Forum's Executive Opinion Survey.[44] 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 talented individuals, in a society that does not allow them to access education and move ahead, will not be leveraged for economic advancement and they may leave the country to pursue opportunities abroad. Additionally, low expectations for the future in a context of high unemployment and persistent inequality can spark political instability. On a broader conceptual level, social mobility is also a direct measure of the freedom to pursue human development. Finally, high youth unemployment can reduce social cohesion and incur significant economic and social costs. It depresses lifetime earnings for unemployed workers, taking a toll on their health and reducing the potential of the next generation to succeed. From an economic standpoint, high youth unemployment reflects a failure to mobilize existing resources and build productive skills.

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 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 selected according to three categories (see Figure 3) aimed at covering the most relevant aspects of 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 regulations along with the extent to which land areas are protected, providing an assessment of a country's commitment to protecting natural capital. We also include a measure of the number of key international environmental treaties, out of a total of 25, in which the country is a participant. 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 cover change, which takes into account reported information about the percentage of total land area that is deforested (or afforested) over time; and the exploitation of fishing grounds. A diminishing regeneration 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 remain available for future generations.

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 negative 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 not to include climate change as a specific factor in this pillar. This is because there is currently no agreement on how to attribute emission responsibilities 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.

While the variables described in this and the previous sections capture a number of important aspects of social and environmental sustainability, 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 and additional environmental indicators. However, as noted in Box 3, because of the lack of quality indicators in these areas we are unable to include them for the time being.

Calculation of the sustainability-adjusted GCI

The two areas of sustainability—social and environmental—are treated as independent adjustments to each country's performance in the 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 the two effects.

Lacking clear theoretical guidelines in 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 result is an adjusted score of a maximum of 20 percent lower or 20 percent higher than the underlying GCI score.

The single indicators are aggregated using a simple average. Although this aggregation method is transparent and simple to replicate, its limitation is that it allows for compensation across the different sustainability dimensions. This needs to be kept in mind when interpreting the results, especially on environmental sustainability. For example, Brazil performs well on a number of environmental indicators but ranks poor in terms of deforestation. By construction, the poor performance on the forest cover change indicator is compensated for by the good results in other areas; consequently Brazil attains an above-average performance for environmental sustainability despite deforestation.

Box 3: Data limitations and a plea for better sustainability data

High-quality data on the social and the environmental dimensions of sustainability are critical for international benchmarking, tracking progress, and analyzing relationships between the different dimensions. Yet, despite the great effort of many organizations to assess some aspects of sustainability, data availability is not satisfactory and the lack of a complete, high-quality global dataset represents a relevant and severe limitation to the ability to compare data across countries and benchmark progress over time.

Even when data are available, they are in many cases not collected on a regular basis, measure concepts that are either too broad or too narrow, or are not calculated with a consistent methodology across countries. For example, youth unemployment is not measured according to the same methodology across countries and the related datasets are not updated regularly. As a result, figures are in some cases more than five years old and hence are incapable of reflecting the rapidly changing reality on the ground, for example following the most recent financial crisis. Using out-of-date figures can be misleading for policymakers, who require statistics that accurately reflect the current situation in order to gain a sense of the effectiveness of their reform efforts.

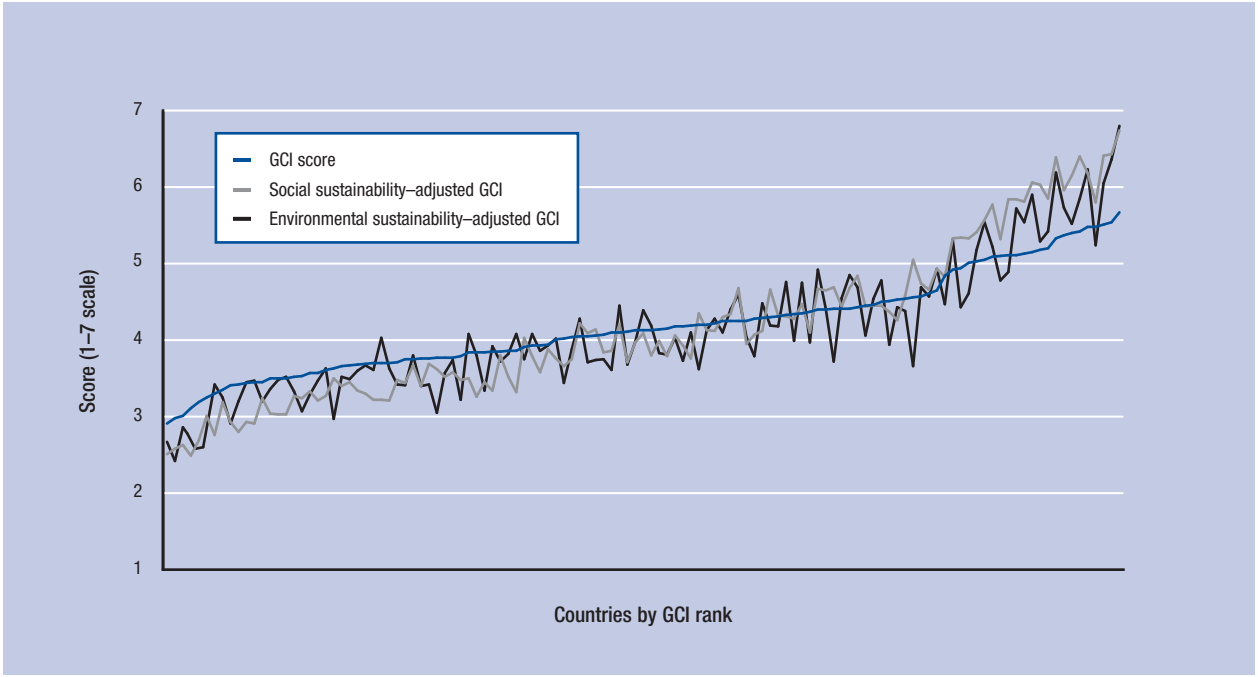
At the same time, for a number of key concepts of sustainability, indicators are simply not available. The absence of such indicators is reflected in our assessment of sustainable competitiveness: a number of measures that we recognize as relevant and would like to include in our methodology are missing, and hence the results reflect an "omitted variables" bias.

Some of the most relevant missing indicators include:

- *Inclusion of minorities.* A measure of how homogenous and how well integrated the social fabric is would provide a relevant component of social sustainability. Although there is no evidence that the exclusion of minorities can cause instability, it is widely recognized that this can be a source of tensions and political polarization.
- *Civil and political rights.* Political and civil rights, such as freedom of speech and freedom of association, facilitate higher levels of transparency and support a system of checks and balances. They generally result in more inclusive governance systems that ensure that the benefits of progress are distributed more widely within the society. Although some indicators in this domain exist, the intangible nature of the topic does not easily allow for a quantitative assessment of the level of political rights present in a country.
- *Real purchasing power of households.* In the context of social sustainability, it is desirable to ensure that salaries allow for a sufficient and secure income and full participation in the country's prosperity and opportunities. Although several studies at the local level highlight the erosion of the purchasing power of households in several advanced economies, this phenomenon does not emerge in our analysis because it cannot be captured by the indicators used in our methodology. Despite the efforts of the International Labour Organization, which has published statistics on labor rights and productive work, 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.
- *Welfare schemes.* Although preferences for the generosity of welfare schemes may differ across countries, these schemes should be affordable in the long run without placing a major burden on public finance. A measure of the financial sustainability of social protection for a large number of countries would allow us to better assess the balance of social protection and public finance.
- *Water stress.* As water is one of the most critical resources for human life as well as for economic activity, sound water indicators are of primary importance. Currently such indicators are not available for a large number of countries because their measurement is very complex. One challenge comes from the fact that water is unevenly distributed on the planet, it flows through national borders, and it can be used for more than one purpose. Another difficulty originates from the fact that water is used differently according to its availability. For example, agricultural products change in different climates: water-intensive products such as paddy rice are most likely produced in areas with abundant water. Consequently, a relevant indicator should measure the actual level of net water available compared with the needs of the population and businesses. The Forum is in contact with the World Research Institute (Aqueduct) program to develop a water stress indicator to be included in the sustainable competitiveness framework in future iterations.
- *Water pollution.* The availability of clean water determines the health of the population and indirectly affects migration patterns. Managing water efficiently requires minimizing water use as well as keeping the water tables fully usable. Internationally comparable data on water quality could contribute to further highlighting the issue.
- *Recycling.* Being able to re-use material is critical to the ability to continue producing new goods without depleting the mineral and natural resources available. An assessment 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 for avoiding the careless disposal of dangerous materials that affect the health of the population. Unfortunately, cross-country data that can measure the management of waste are not yet available.

In order to bridge the gap in measuring sustainability, a wider international effort is required. This challenge can be met by pooling resources to produce and collect the data and by defining global measurement standards. To contribute to data production and collection, in 2012 the World Economic Forum created the Global Agenda Council on Measuring Sustainability. One of the main objectives of the Council is to create a platform to enable and incentivize data collection from different sources and make them available for researchers and the public at large. Additionally, the Council aims to bring scientists and policymakers together to develop new sustainability indicators.

Figure 4: Country performance on the GCI and the components of the sustainability-adjusted GCI



Nothwithstanding extensive research efforts, we were not able to identify new metrics of appropriate quality to be included in the index. At the same time, based on a detailed review of the structure of the two pillars, the indicator *Forest loss* has been dropped because of its overlap with the indicator *Forest cover change.*

In this year's Sustainable Competitiveness exercise, we are able to increase the country coverage to 121 economies, up from 79 in the previous edition of the *Report.* This significant increase in coverage is mainly the result of dropping the indicator *Forest loss,* which was not available for a number of countries. Yet coverage remains lower than for the GCI, which includes 148 economies this year.

Results of the sustainability-adjusted GCI analysis

In this section, the results from the sustainability-adjusted GCI analysis are presented. Table 1 shows how the GCI score is adjusted once sustainability indicators are taken into account. An upward arrow shows that sustainability results drive a better score than the GCI itself; a downward arrow points to a situation of vulnerability in terms of social and/or environmental sustainability that lowers the GCI score. A "flat" arrow indicates that GCI results do not change substantially once sustainability aspects are taken into account.

As Figure 4 shows, the results indicate that there is no clear trade-off between being competitive and being sustainable. Countries attain results on the two elements of sustainability that are above or below the competitiveness score at all levels of competitiveness. However, countries in the top half of the competitiveness rankings tend to perform better on sustainability as well. This is particularly true for the social sustainability dimension, which is, not surprisingly, highly correlated with the level of development. Developed economies tend to have more mature institutions that ensure that citizens have access to basic infrastructure, health, and welfare. At the same time, countries that face challenges related to their competitiveness fare even more poorly in terms of social sustainability.

In terms of environmental sustainability, the picture is more complex. Countries toward the lower end of the competitiveness scale tend to fare better than advanced economies in terms of emissions such as CO_2, as well as manufacturing-related pollution such as waste and by-products of industrial processes.[45] However, these economies are currently facing problems that advanced economies have already experienced in their own earlier stages of development, such as biodiversity loss caused by deforestation, urbanization, and the expansion of agricultural land as well as air pollution (measured here through particulate matter, or $PM_{2.5}$, emissions) triggered by the use of older combustion technologies, especially in the transport sector. Therefore, not surprisingly, cities in countries such as Bangladesh, Brazil, China, India, and Nigeria are among some of the most polluted areas on the planet.

RESULTS FOR SELECTED ECONOMIES

Switzerland remains at top of the sustainability-adjusted GCI and shows a high level of sustainability on both the social and environmental dimensions of the index. Low unemployment combined with relatively good social protection enables Switzerland to perform well on the social dimension. In terms of environmental sustainability, although results are positive in comparison with other countries, the treatment of chemicals and air pollutant emissions appear to be areas for improvement. The performance of Switzerland demonstrates that there is no necessary trade-off between being environmentally and socially sustainable on the one hand and being competitive on the other. In general terms, countries that are close to the innovation frontier can innovate and manage their resources effectively, and in fact these countries are often keener to monitor possible sustainability concerns and to put in place policies to address them. Although Switzerland does not yet attain the maximum possible score, indicating there are still areas for improvement, the country's leadership and population are certainly aware of the pressures on environmental resources and social issues and do much to address them.

Similarly, **Nordic** countries perform well in terms of sustainability. **Norway** is the only other country (besides Switzerland) that attains very strong results in both aspects of sustainability, being the only country in the Nordics with youth unemployment below 10 percent and wide-ranging social protection combined with low emissions and good land management on the environmental side. One area for improvement is Norway's depleting fish stock. **Finland** attains a similar performance, scoring well especially on the social dimension with a high level of social protection and universal access to healthcare; however, these good results are partially offset by a relatively high youth unemployment figure (20.3 percent). In terms of environmental sustainability, Finland is also relatively sustainable with strict regulations, low water stress, and low emissions. However, little protected land area and some pressure on fish stocks prevent the country from attaining an even better result. **Sweden** also performs well both in terms of social and environmental sustainability, but at a lower level than other Nordic countries, especially on the social pillar where the country's persistently high youth unemployment rate continues to weigh heavily. In terms of environmental sustainability, Sweden attains a result similar to Finland, with generally responsible management of resources; limitations are seen, however, in some concerns over depleting fish stocks and very little protected land area.

Germany performs relatively well on both aspects of sustainability. On the social sustainability pillar, relatively low youth unemployment, wide access to healthcare, and the presence of a social safety net are the main drivers of the positive assessment. Some emerging social difficulties, such as the increasing number of employed people who rely on the welfare state, may put the country's social sustainability at risk.[46] Environmental sustainability is also relatively positive. Stringent and well-enforced regulations and the existence of a large amount of protected land indicate Germany's particular attention to environmental issues. However, despite the country's efforts, some areas for improvement remain. CO_2 intensity is still relatively high, although slowly diminishing, and fish stocks appear somewhat overexploited.

The performance of the **United States** in terms of sustainable competitiveness is, as in the previous edition, modest, with somewhat better results for social than environmental sustainability. The country's social sustainability score is somewhat lower than that of other advanced economies because of high income inequality and relatively high youth unemployment (17.3 percent). According to the 2012 assessment from the US Census Bureau, more than 16 percent of the population lived in poverty in the United States—a worse result than the 14.3 percent of 2009 and a sign of increasing polarization within the income structure. In terms of environmental sustainability, the below-par performance of the United States is the consequence of several factors that include the country's lack of commitment to joining international treaties, its limited political will to firmly improve on critical environmental issues, the high pressure on its water resources for agriculture, its relatively high CO_2 emissions, and limited protected land area. This aligns with the concerns highlighted by the US Environmental Protection Agency (EPA) on the need to protect habitats, especially on the coasts where urbanization is moving faster. The EPA recognizes that the loss of open land and forest because of its conversion to urban areas or agricultural uses is a significant threat to natural habitats.[47] On a more positive note, air quality is improving somewhat in several areas in the country.

Japan receives a relatively positive assessment in the social sustainability component, performing better than other economies thanks to low youth unemployment, a small informal economy, and a sound social safety net. However, the country also displays a relatively high level of income inequality. On the environmental side, Japan's performance is more mixed. The country is doing well in terms of environmental policies (with high commitment to ensuring that regulations and standards are in place), yet it continues to face a high level of CO_2 emissions and it faces some pressure on water resources and on fish stocks.

Among other countries performing well in terms of environmental sustainability, **New Zealand** emerges as an economy with a strongly articulated political commitment to environmental stewardship. It performs

Table 1: Adjustment to the GCI scores by sustainability indicators

	GCI 2013–2014		Social sustainability–adjusted GCI†		Environmental sustainability–adjusted GCI‡		Sustainability-adjusted GCI‡‡	
Country/Economy	Rank*	Score	Score	Direction	Score	Direction	Score	Direction
Switzerland	1	5.67	6.74	⇑	6.80	⇑	6.77	⇑
Finland	3	5.54	6.43	⇑	6.36	↗	6.40	⇑
Germany	4	5.51	6.41	⇑	6.05	↗	6.23	↗
United States	5	5.48	5.80	↗	5.24	⇒	5.52	⇒
Sweden	6	5.48	6.18	↗	6.23	↗	6.21	↗
Netherlands	8	5.42	6.40	⇑	5.85	↗	6.13	↗
Japan	9	5.40	6.15	↗	5.52	⇒	5.83	↗
United Kingdom	10	5.37	5.96	↗	5.73	↗	5.85	↗
Norway	11	5.33	6.39	⇑	6.19	⇑	6.29	⇑
Canada	14	5.20	5.85	↗	5.42	⇒	5.64	↗
Denmark	15	5.18	6.03	⇑	5.29	⇒	5.66	↗
Austria	16	5.15	6.06	⇑	5.90	↗	5.98	⇑
Belgium	17	5.13	5.81	↗	5.54	↗	5.67	↗
New Zealand	18	5.11	5.84	↗	5.72	↗	5.78	↗
United Arab Emirates	19	5.11	5.84	↗	4.89	⇒	5.37	⇒
Saudi Arabia	20	5.10	5.32	⇒	4.78	↘	5.05	⇒
Australia	21	5.09	5.77	↗	5.22	⇒	5.50	↗
France	23	5.05	5.57	↗	5.54	↗	5.56	↗
Malaysia	24	5.03	5.41	↗	5.18	⇒	5.29	⇒
Korea, Rep.	25	5.01	5.33	↗	4.61	↘	4.97	⇒
Israel	27	4.94	5.34	↗	4.43	↘	4.89	⇒
Ireland	28	4.92	5.33	↗	5.31	↗	5.32	↗
China	29	4.84	4.83	⇒	4.47	↘	4.65	⇒
Estonia	32	4.65	4.93	↗	4.93	↗	4.93	↗
Chile	34	4.61	4.66	⇒	4.57	⇒	4.61	⇒
Spain	35	4.57	4.74	⇒	4.69	⇒	4.71	⇒
Kuwait	36	4.56	5.05	↗	3.66	⇓	4.36	⇒
Thailand	37	4.54	4.58	⇒	4.38	⇒	4.48	⇒
Indonesia	38	4.53	4.26	↘	4.43	⇒	4.35	⇒
Azerbaijan	39	4.51	4.37	⇒	3.94	↘	4.15	↘
Panama	40	4.50	4.45	⇒	4.78	↗	4.62	⇒
Poland	42	4.46	4.45	⇒	4.54	⇒	4.50	⇒
Turkey	44	4.45	4.44	⇒	4.06	↘	4.25	⇒
Czech Republic	46	4.43	4.84	↗	4.69	↗	4.77	↗
Lithuania	48	4.41	4.68	↗	4.85	↗	4.76	↗
Italy	49	4.41	4.44	⇒	4.55	⇒	4.50	⇒
Kazakhstan	50	4.41	4.69	↗	3.72	⇓	4.20	⇒
Portugal	51	4.40	4.65	↗	4.41	⇒	4.53	⇒
Latvia	52	4.40	4.67	↗	4.92	↗	4.80	↗
South Africa	53	4.37	4.10	↘	3.97	↘	4.03	↘
Costa Rica	54	4.35	4.47	⇒	4.75	↗	4.61	↗
Mexico	55	4.34	4.28	⇒	3.99	↘	4.13	⇒
Brazil	56	4.33	4.31	⇒	4.76	↗	4.53	⇒
Bulgaria	57	4.31	4.32	⇒	4.18	⇒	4.25	⇒
Cyprus	58	4.30	4.66	↗	4.19	⇒	4.42	⇒
Philippines	59	4.29	4.12	⇒	4.48	⇒	4.30	⇒
India	60	4.28	4.07	⇒	3.79	↘	3.93	↘
Peru	61	4.25	3.95	↘	4.04	⇒	4.00	↘
Slovenia	62	4.25	4.68	↗	4.60	↗	4.64	↗
Hungary	63	4.25	4.34	⇒	4.40	⇒	4.37	⇒
Russian Federation	64	4.25	4.30	⇒	4.10	⇒	4.20	⇒
Sri Lanka	65	4.22	4.12	⇒	4.28	⇒	4.20	⇒
Montenegro	67	4.20	4.13	⇒	4.13	⇒	4.13	⇒
Jordan	68	4.20	4.35	⇒	3.62	↘	3.98	⇒
Colombia	69	4.19	3.76	↘	4.10	⇒	3.93	↘
Vietnam	70	4.18	3.93	↘	3.73	↘	3.83	↘
Ecuador	71	4.18	4.06	⇒	4.03	⇒	4.05	⇒
Georgia	72	4.15	3.79	↘	3.81	↘	3.80	↘
Macedonia, FYR	73	4.14	3.99	⇒	3.83	↘	3.91	⇒
Botswana	74	4.13	3.80	↘	4.19	⇒	3.99	⇒
Croatia	75	4.13	4.09	⇒	4.39	↗	4.24	⇒

(Cont'd.)

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

	GCI 2013–2014		Social sustainability–adjusted GCI†		Environmental sustainability–adjusted GCI‡		Sustainability-adjusted GCI‡‡	
Country/Economy	Rank*	Score	Score	Direction	Score	Direction	Score	Direction
Romania	76	4.13	3.97	⇒	3.98	⇒	3.97	⇒
Morocco	77	4.11	3.71	↘	3.68	↘	3.70	↘
Slovak Republic	78	4.10	4.21	⇒	4.45	⇗	4.33	⇗
Armenia	79	4.10	3.86	↘	3.61	↘	3.74	↘
Iran, Islamic rep.	82	4.07	3.84	↘	3.75	↘	3.80	↘
Tunisia	83	4.06	4.14	⇒	3.74	↘	3.94	⇒
Ukraine	84	4.05	4.09	⇒	3.71	↘	3.90	⇒
Uruguay	85	4.05	4.22	⇒	4.28	⇗	4.25	⇒
Guatemala	86	4.04	3.75	↘	3.88	⇒	3.82	↘
Bosnia and Herzegovina	87	4.02	3.66	↘	3.44	↘	3.55	↘
Cambodia	88	4.01	3.76	↘	4.02	⇒	3.89	⇒
Moldova	89	3.94	3.88	⇒	3.93	⇒	3.91	⇒
Namibia	90	3.93	3.58	↘	3.86	⇒	3.72	⇒
Greece	91	3.93	3.79	⇒	4.08	⇒	3.94	⇒
Trinidad and Tobago	92	3.91	4.03	⇒	3.75	⇒	3.89	⇒
Zambia	93	3.86	3.32	↘	4.08	⇗	3.70	⇒
Jamaica	94	3.86	3.52	↘	3.82	⇒	3.67	⇒
Albania	95	3.85	3.80	⇒	3.72	⇒	3.76	⇒
Kenya	96	3.85	3.34	↘	3.92	⇒	3.63	↘
El Salvador	97	3.84	3.45	↘	3.34	↘	3.40	↘
Bolivia	98	3.84	3.26	⇓	3.80	⇒	3.53	↘
Nicaragua	99	3.84	3.50	↘	4.08	⇗	3.79	⇒
Algeria	100	3.79	3.48	↘	3.22	⇓	3.35	↘
Serbia	101	3.77	3.58	↘	3.74	⇒	3.66	⇒
Guyana	102	3.77	3.52	↘	3.57	↘	3.54	↘
Lebanon	103	3.77	3.62	⇒	3.05	⇓	3.34	↘
Argentina	104	3.76	3.69	⇒	3.42	↘	3.55	↘
Dominican Republic	105	3.76	3.40	↘	3.40	↘	3.40	↘
Suriname	106	3.75	3.67	⇒	3.80	⇒	3.74	⇒
Mongolia	107	3.75	3.44	↘	3.41	↘	3.43	↘
Bangladesh	110	3.71	3.48	↘	3.42	↘	3.45	↘
Honduras	111	3.70	3.21	↘	3.63	⇒	3.42	↘
Gabon	112	3.70	3.22	↘	4.03	⇗	3.62	⇒
Senegal	113	3.70	3.22	↘	3.61	⇒	3.41	↘
Ghana	114	3.69	3.30	↘	3.67	⇒	3.48	↘
Cameroon	115	3.68	3.34	↘	3.60	⇒	3.47	↘
Gambia, The	116	3.67	3.45	↘	3.49	↘	3.47	↘
Nepal	117	3.66	3.40	↘	3.52	⇒	3.46	↘
Egypt	118	3.63	3.50	⇒	2.97	⇓	3.23	↘
Paraguay	119	3.61	3.27	↘	3.63	⇒	3.45	⇒
Nigeria	120	3.57	3.21	↘	3.47	⇒	3.34	↘
Kyrgyz Republic	121	3.57	3.33	↘	3.29	↘	3.31	↘
Cape Verde	122	3.53	3.24	↘	3.07	↘	3.15	↘
Swaziland	124	3.52	3.27	↘	3.33	↘	3.30	↘
Tanzania	125	3.50	3.03	↘	3.52	⇒	3.27	↘
Côte d'Ivoire	126	3.50	3.03	↘	3.48	⇒	3.25	↘
Ethiopia	127	3.50	3.04	↘	3.36	⇒	3.20	↘
Liberia	128	3.45	3.24	↘	3.20	↘	3.22	↘
Benin	130	3.45	2.91	⇓	3.47	⇒	3.19	↘
Zimbabwe	131	3.44	2.93	↘	3.45	⇒	3.19	↘
Madagascar	132	3.42	2.80	⇓	3.20	↘	3.00	↘
Pakistan	133	3.41	2.93	↘	2.91	↘	2.92	↘
Venezuela	134	3.35	3.19	⇒	3.25	⇒	3.22	⇒
Mozambique	137	3.30	2.76	⇓	3.42	⇒	3.09	↘
Timor-Leste	138	3.25	3.01	↘	2.60	⇓	2.81	↘
Mauritania	141	3.19	2.69	⇓	2.58	⇓	2.63	⇓
Haiti	143	3.11	2.49	⇓	2.78	↘	2.63	⇓
Sierra Leone	144	3.01	2.63	↘	2.86	↘	2.74	↘
Yemen	145	2.98	2.58	↘	2.42	⇓	2.50	⇓
Guinea	147	2.91	2.51	↘	2.67	↘	2.59	↘

* This is the GCI rank, as presented in Chapter 1.1. Only the 121 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%

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 as well.

The **United Arab Emirates** emerges as somewhat socially sustainable, although its environmental performance shows some weaknesses. Low youth unemployment and wide access to basic necessities (sanitation and drinking water) drive these fairly positive results. In terms of environmental sustainability, however, high pressure on water resources (partially the result of geographic conditions) and a high concentration of particulate matter lead to an overall below-par performance. In addition, the country is signatory to fewer international environmental treaties than most countries, and CO_2 emissions, although decreasing, are also relatively high.

China's competitiveness is overall less positive once the sustainability measures are taken into account. The environmental sustainability component particularly is less positive. In terms of social sustainability, China's performance is comparable to its overall competitiveness score, although this may be affected by the fact that the country does not report data related to youth unemployment or vulnerable employment. Access to improved drinking water and sanitation are improving slightly, as is the perceived access to healthcare, and there is some access to a social safety net. However, the fraction of the population covered by the welfare system is still relatively small and is restricted mainly to full-time urban workers, and 35 percent of the population still does not have access to improved sanitation facilities. Additionally, income inequality is high, with stark differences across different geographical areas but also within cities; this situation has driven the government to consider raising the national minimum wage to 40 percent of average urban salaries by 2015.

It is, however, the environmental sustainability dimension in which China's competitiveness may encounter the most important challenges. The level of emissions (both CO_2 and $PM_{2.5}$ particles) continues to rise, and air pollution is worsening in several cities. The agricultural sector places a great deal of pressure on the environment (e.g., China's water intensity is very high). Water pollution is also pervasive, with the ecosystem of water streams severely damaged. Rapid industrialization has taken a heavy toll on the Chinese natural environment, especially in terms of pollution, and—according to a study from the Beijing-based Chinese Academy for Environmental Planning—this has also resulted in productivity loss. Health issues, crop degradation, and losses from pollution-related accidents have reduced China's productivity, with the total cost arising from pollution estimated at 3.1 percent of GDP.[48] The tangible deterioration of natural capital has induced the government to plan changes to the way resource use is taxed: according to the Chinese press,[49] the government envisages changing the taxation of coal in a way that would increase coal prices and discourage the use of this fuel. Additionally China may introduce a tax on water use. The Chinese leadership's growing focus on the natural environment will be important for placing the country on a more sustainable path over the next few years.

Indonesia's assessment on sustainable competitiveness brings down the country's GCI result. In terms of social sustainability, the primary area of concern is the significant share of the population in vulnerable employment. Additionally, access to sanitation remains low (40 percent of the population does not have regular access to sanitation facilities) and access to healthcare services is inadequate. From an environmental perspective, sustainability is threatened by the high rate of deforestation, which is depleting the country's forests and destroying the habitat of a highly biodiverse ecosystem. Logging and agriculture are taking the highest toll on Indonesia's forests, which could be protected by stricter enforcement of environmental regulations. In addition to deforestation, Indonesia's environmental issues include a rising level of CO_2 emissions and the relatively high intensity of water use for agriculture. Beyond the assessment of this framework, marine pollution is also reported to be severely damaging Indonesia's coral reefs.[50]

Turkey attains a middling score on the social sustainability dimension and a lower score in the environmental sustainability–adjusted GCI than it does in the GCI itself. In terms of social sustainability, the country's relatively high youth unemployment, its large informal sector, and its limited social protection continue to represent its main challenges. In terms of environmental sustainability, high CO_2 emissions, intensive water use for agriculture, and limited protected land area together with a lack of commitment to international environmental agreements contribute to diminishing the sustainability of long-term competitiveness.

South Africa's social sustainability is undermined by high income inequality and youth unemployment. In addition, the country has not yet achieved universal access to sanitation. On a more positive note, the share of the population in vulnerable employment is relatively low and social mobility is somewhat better than it is in many other countries at a similar stage of development. From an environmental point of view, South Africa's performance is weakened mainly by increasing CO_2 emissions and strained water and fish stock resources. Soil erosion and practices connected with commercial farming, such as the use of pesticides, add to the pressures on the environment.

Brazil's results on sustainable competitiveness are in line with its GCI score, and it has a somewhat more positive assessment on environmental sustainability. The size of the country and the richness of its natural assets result in relatively positive aggregate results in areas such as emissions and air quality. In addition, environmental regulation has become stricter following recent efforts to undo the damage inflicted on the natural environment that occurred in the process of industrialization. However, some issues—such as the country's long-running deforestation—do not seem to be improving. The Brazilian government disclosed figures earlier this year pointing toward further deforestation in the Amazon, undoing recent progress in preserving the rainforest.[51] In terms of social sustainability, the population's high income inequality and poor access to health and sanitation is damaging the country's capacity to sustain its competitiveness. Protests recently took place in several of Brazil's cities, and although the causes are complex, some of the country's socioeconomic intricacies play a key role. Inefficient and expensive public transport, rising prices compared to the level of salaries, and poor access to credit, combined with strong income disparities, are undermining social sustainability in the country.

India's sustainable competitiveness is also characterized by concerns in both areas of sustainability. On the social sustainability side, India's performance is hindered by lack of access to basic sanitation and health services for many of its citizens (only 35 percent of the population has access to improved sanitation). Also, despite the introduction of the National Social Assistance Programmes (NSAP) in 1995, the share of population covered by the social safety net is still relatively small. This issue, combined with a large informal sector and a high share of the workforce in vulnerable employment, makes it difficult to manage the country's growing income inequality. Altogether these structural issues make India's competitiveness vulnerable to shocks. India's environmental performance also hinders the achievement of sustainable competitiveness. A high level of emissions (especially in terms of particulate matter concentration) and few protected areas are wearing down the quality of the natural environment. Additionally, high agricultural water-use intensity is depleting water tables because usage is above their regenerative capacity. According to the Ministry of Water Resources, "68% of the country is prone to drought in varying degrees of which 33% is chronically drought prone."[52] Agriculture use, industrial use, increasing population, infrastructure gaps, and contamination exacerbate the water scarcity issue. The Ministry of Water Resources reports that: "high incidence of fluoride, arsenic, iron & heavy metals has been found in isolated pockets" in several states.[53]

Peru's competitiveness is also reduced once sustainability measures are taken into account in both the social and environmental areas. Regarding social sustainability, Peru is characterized by high income inequality, which is worsened by a large informal economy that leaves many people unprotected. Although the country's strong growth contributes to slowly reducing unemployment, and although measures to improve primary education, nutrition, and childcare have been taken by the government, a weak social safety net exposes workers to shocks and access to healthcare is far from being universal. On the environmental sustainability front, although a high share of Peru's surface is forested—partially thanks to the creation of several protected land areas—the enforcement of environmental regulations is quite lax, to the detriment of efforts to preserve the environment. For example, illegal logging is a menace as authorities struggle to fight the phenomenon effectively. In addition, the level of CO_2 emissions is on the rise, spurred by an increased level of industrial activity, while the fishery sector, one of the key export areas for the country, is registering a depletion of fish stock. Another environmental issue is the pollution of water resources, especially in areas with strong mining development, which has recently spurred several local protests in the country.

The **Russian Federation** attains an intermediate performance with a sustainability score in line with its GCI results across both pillars, although some important challenges may undermine the country's sustainability going forward. In terms of social sustainability, the Russian Federation is characterized by a relatively weak social safety net, high and increasing inequality, and limited social mobility. In terms of environmental sustainability, its lax environmental regulations, resource depletion, and the slowly degrading quality of its natural environment emerge as the most important challenges for the country's leadership. The Russian Federation is endowed with rich natural resources—including some of the largest water reserves in the world and widespread forests. The consequence is that the country still performs relatively well on several environmental indicators in international comparison, despite the depletion of those resources.

Colombia's competitiveness is pulled down once sustainability is taken into account. In terms of social sustainability, income inequality is high, over 20 percent of households still do not have access to improved sanitation, and access to healthcare services is fraught with difficulties. Additionally, despite efforts by the government, the social safety net is still not very strong in a country where over 30 percent of the population lives in poverty, although it should be noted that poverty is declining. The difficult economic situation of many households hinders social mobility, which reinforces persistent income inequality. This inequality is further

exacerbated by—according to the OECD—the country's high unemployment and the fact that the majority of those working are employed in informal, and often low-productivity, jobs, which in turn cements labor market segmentation. In terms of environmental sustainability, Colombia's performance is comparable with its competitiveness results. Colombia is one of the most biologically diverse countries on the planet, has little pressure on its water tables, and has several protected land areas. However, a number of factors threaten the country's unique biodiversity. First, the somewhat weak enforcement of environmental regulations limits the effect of establishing protected areas and fails to abate pollution. Additionally, deforestation is occurring because of the country's growing population, infrastructure development, illegal logging in coastal tropical rainforests, small-scale agricultural activities, mining, and the cocaine trade. According to international studies,[54] each year Colombia loses nearly 200,000 hectares of natural forest. According to the World Bank, a 2006 study found that the costs of environmental degradation—including air pollution and inadequate water, sanitation, and hygiene—amounted to 3.7 percent of Colombia's GDP,[55] limiting Colombia's long-term sustainable competitiveness.

Vietnam's GCI performance is weakened once sustainability measures are considered. In terms of social sustainability, the main issues are the country's lack of access to healthcare services, its insufficient social mobility, and the large segments of its population in vulnerable employment. Although Vietnam's social sustainability is not very strong, the challenges are even more significant in the environmental domain. First, regulations are assessed as lax and not well enforced, an attitude that is also reflected in the country's low level of commitment to international treaties. In addition, Vietnam has a high level of particulate matter concentration and CO_2 emissions. Moreover, the pressure on water resources and fish stocks is relatively high. Overall, the rapid industrialization of the country is having a strong negative impact on the environment, including air and water pollution (not fully measured by this framework), which together may put the country's long-term competitiveness and the living conditions of the citizens in jeopardy if more sustainable processes are not adopted.

Zambia's competitiveness is weakened especially by social sustainability issues, while on the environmental front, despite some ongoing concerns, its performance is in line with its competitiveness. Access to sanitation, improved drinking water, and healthcare services are still very limited, which—together with the large portion of the population working in vulnerable employment—explains the negative performance on the social dimension. In addition, income is unevenly distributed, and the country has one of the highest income Gini coefficients in the world. In terms of environmental sustainability, Zambia protects a large portion of its land, has relatively stringent regulations, and manages to keep the level of CO_2 emissions low, which together contribute to its above-average performance on this dimension. However, issues such as the net loss of forests and water pollution connected especially with the lead processing and mining industry still need to be addressed. Because of high levels of lead in some areas, Zambian children average a lead concentration in their blood that is between five and ten times greater than what is considered safe by the US Environmental Protection Agency. The World Bank has allocated approximately US$40 million toward a clean-up project in these areas.[56]

Kenya's sustainable competitiveness is similarly weakened especially by the social dimension, while environmental sustainability is not presently affecting its score. The data point to a need for developing certain areas of social sustainability. Access to improved drinking water, healthcare services, and sanitation facilities are limited (the latter are available for less than 30 percent of the population). A significant share of the population still relies on vulnerable employment, and widespread poverty is exacerbated by a lack of social mobility. In terms of environmental sustainability, Kenya has put into place a relatively well enforced regulatory framework, is committed to international treaties, and has created several protected land areas. In addition, in line with its position in the industrialization process, the country's level of emissions (both CO_2 and particulate matter) is low, limiting such damage to the natural environment. Yet protection of forests and habitats remains an issue, with logging related to timber production and agriculture reducing the stock of forests faster than their natural regenerative capacity. Water scarcity also needs to be addressed, as intense agriculture use and pollution are limiting the availability of water to the population.

In **Senegal,** the main areas of vulnerability are found in social sustainability. Although somewhat better than other sub-Saharan African countries, access to improved sanitation is limited (only 51 percent of the population has access) while access to improved drinking water is broader (73.4 percent), yet still needs to be improved. In addition, large portions of the population do not have access to healthcare services and are not protected by a social safety net. This is partly the result of the large informal economy and the fact that almost 80 percent of the total employed population works in vulnerable employment. On a more positive note, Senegal appears to be somewhat less unequal than some rapidly growing economies. Its income Gini coefficient is 40.3 (a level similar to that of Turkey)—better, for example, than those of Ghana or Kenya. The environmental sustainability pillar, despite an overall performance that is in line with the GCI, also presents some areas of concern.

Overexploited fish stocks, deforestation, and air and water pollution are the main problems that Senegalese authorities need to manage. These issues, which emerge from the indicators assessed in the sustainable competitiveness framework, are also mentioned by the World Wildlife Fund (WWF)—with the addition of water pollution and overgrazing—as being among the most prominent environmental problems in Senegal.[57] However, the country is attempting to protect the environment by, for example, creating several protected land areas and committing to most of the international environment treaties. Additionally, and partly because of its level of development, its CO_2 emissions are relatively low. By focusing on these dimensions, Senegal could achieve a more sustainable development path.

Ghana's sustainability assessment unveils particular pressures on the social sustainability pillar where, despite continued growth, access to improved sanitation is still very low and the development process has not yet benefitted large portions of the population that have vulnerable jobs or work in the informal economy and do not have access to social security. Additionally, and partially as a result of this structure, income inequality is relatively high and on the rise,[58] highlighting the non-inclusive economic growth in the country. This in turn could lead to social tensions in the longer term. In terms of environmental sustainability, Ghana attains a better result with low CO_2 emissions and relatively sustainable fishing practices. However, some concerns remain. First, deforestation is depleting natural resources at a rapid rate. According to the WWF,[59] Ghana can sustainably produce about 1 million cubic meters of timber from its forest reserves and agricultural lands; however, it is currently producing much more, and reached a peak in 2002 when the harvested timber was about four times the regenerating capacity. In addition to logging, commercial agriculture is damaging the country's forest by clearing the land by means of burning and cutting wooded areas. Second, mining activity and the use of agricultural pesticide impacts groundwater by polluting water streams and aquifers. Third, the pressure on water resources in areas where the population is growing quickly is high, while water is not steadily available throughout the year. This results in water rationing, and in some cases creates tensions for water access among citizens. More efficient resource management would enable Ghana to preserve its natural wealth and improve the living conditions of its citizens.

CONCLUSIONS AND NEXT STEPS

Sustainable competitiveness is a nascent area of research. Our initial work has shown that progress on the conceptual side as well as advances with respect to data for measuring key concepts will be necessary to better inform decisions that have implications for the economic, social, and environmental dimensions of sustainable competitiveness. In an effort to proceed toward a better understanding of sustainable competitiveness, this chapter develops further the conceptual framework for sustainable competitiveness introduced by the World Economic Forum in 2011. By combining social and environmental indicators with the GCI, we have been able to develop a preliminary framework for measuring the concept and to carry out a preliminary analysis of national sustainable competitiveness.

The most important finding of this analysis is that there is no necessary trade-off between being competitive and being sustainable. Many countries at the top of the competitiveness rankings are also the best performers in many areas of sustainability. Going forward, economies that are able to balance economic progress with social inclusion and good and effective environmental stewardship will most likely experience higher rates of human progress and prosperity.

Given the complexity of the issue at hand and important gaps in data to measure key elements of sustainable competitiveness, the endeavor to measure sustainable competitiveness has been designed as a multi-year process. The World Economic Forum will continue to serve the international community by providing a neutral multi-stakeholder platform to advance the understanding and analysis of this important concept.

One crucial element of this strand of work will focus on obtaining more and better metrics to fully assess sustainable competitiveness, as a number of key concepts still cannot be captured. The World Economic Forum's Global Agenda Council on Measuring Sustainability will work to develop better and more complete datasets. And as in previous years, the Advisory Board on Sustainability and Competitiveness will contribute to improving the conceptual foundations of sustainable competitiveness and the measurement methodology going forward.

NOTES

1 See UNDP 2011 for an overview of trends and patterns related to growth and social and environmental sustainability.

2 References to studies on growth and environment are provided in note 6 and for studies on growth and inequality in note 26.

3 This definition is from the World Commission on Environment and Development's (the Brundtland Commission) report *Our Common Future.* This report is commonly known as "the *Brundtland Report.*"

4 Porter and van der Linde 1995.

5 Brock and Taylor 2004; Nordhaus 2002; Bovenberg and Smulders 1996; and Acemoglu 2009.

6 Nordhaus 1992.

7 See, for example, Barbier 1997 and Yandle et al. 2000.

8 This conclusion would be misleading for at least three reasons: (1) the cumulated level of damage and resource scarcity may reach a critical point before the economy cleans up without interventions, (2) early damage to the environment might not be reversible and is not completely neutralized in any case, and (3) a higher level of income may not be achievable because of a lack of environmental sustainability.

9 World Bank 2012.

10 Luenberger 1995.

11 See, for example, Worldwatch Institute 2006, issue xxiv.

12 Zivin and Neidell 2011.

13 Information on the Convention on Biological Diversity is available at https://www.cbd.int/development/.

14 See Rockström 2009.

15 Brink et al. 2012.

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

17 UNEP 2011.

18 Gross and Ringbeck 2008.

19 World Bank News 2011.

20 Jaffe and Palmer 1997.

21 UNEP 2011.

22 Alpay et al. 2002.

23 For an exhaustive review of the issue, see Colantonio 2011.

24 World Economic Forum 2013.

25 For an overview on the income inequality problem, see OECD 2011; Mankiw 2013; and Stiglitz 2012.

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

27 OECD 2012.

28 IEA 2012.

29 Spedding et al. 2013.

30 Sexton et al. 2008.

31 See Raleigh and Urdal 2009 for further discussion of this topic.

32 UNCTAD 2011b.

33 See Bäthge 2010 for further discussion of climate change and women's empowerment.

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

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

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

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

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

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

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

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

42 The lack of some additional indicators, especially in the social sustainability dimension, constrains the model and does not allow for a comprehensive measurement of sustainability. For example, Germany performs well on the social sustainability pillar despite an existing trend of decreasing wages in Germany where, according to the Federal Employment Agency, over the past four years the number of individuals who require state support to get by despite full- or part-time jobs has increased steadily. Similarly, in Italy, the Italian National Institute of Statistics (Istat) disseminates the relative and absolute poverty estimations for households in the country, based on 2012 Households Budget Survey data. In 2012 the relative poverty incidence was equal to 12.7 percent, whereas the absolute poverty rate was 6.8 percent. These dimensions, although measured at country level in advanced economies, are not measured worldwide. Additionally, because poverty thresholds change from country to country, it is difficult to establish a cross-country comparison. The Gini index variable does not yet capture similar phenomena in the assessed countries.

43 The lack of access to basic necessities indicates a state of poverty.

44 For more information about the Executive Opinion Survey, please see Chapter 1.3 of this *Report.*

45 These are not covered by this framework; see Box 3.

46 This aspect of social sustainability is not fully reflected in the quantitative measurements because of a lack of available data.

47 See US Environmental Protection Agency, http://www.epa.gov/owow_keep/estuaries/pivot/habitat/problem.htm.

48 Wang et al. 2004.

49 English.news.cn, China. 2013. "China to Introduce Carbon Tax: Official." February 19. Available at http://news.xinhuanet.com/english/china/2013-02/19/c_132178898.htm.

50 See World Resources Institute 2002.

51 Another problematic area contributing to environmental degradation is the lack of waste management, which, because of a lack of data, is not captured in the pillars. As landfills are still the most common way to dispose of waste, growing population and growing consumption are leading to an increase in the size of landfills. This in turn hinders natural areas from being able to sustain life.

52 See the Government of India, Ministry of Home Affairs, available at http://mha.nic.in/par2013/par2013-pdfs/rs-080513/592.pdf; this is based on the Manual for Drought Management published by Department of Agriculture and Cooperation, Ministry of Agriculture, available at http://mha.nic.in/par2013/par2013-pdfs/rs-080513/592.pdf.

53 See the Government of India, Ministry of Water Resources 2010.

54 Calvani 2007.

55 World Bank 2013.

56 See SCGH (Sierra Club GreenHome), "The Cleanest and Most Polluted Cities in the World." Available at http://www.sierraclubgreenhome.com/green-news/the-cleanest-and-the-most-polluted-cities/#sthash.LFwWAd6b.dpuf.

57 See WWF (World Wildlife Fund). "Environmental Problems in Senegal: Fished Out and Running Dry." Available at http://wwf.panda.org/who_we_are/wwf_offices/senegal/environmental_problems__in_senegal/.

58 Ghana Business News 2011.

59 See http://wwf.panda.org/who_we_are/wwf_offices/ghana/problems/.

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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 (the 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 Access to sanitation*[d] $_{(log)}$
- S04 Access to improved drinking water*[d]
- S05 Access to healthcare[d]
- S06 Social safety net protection
- S07 Extent of informal economy
- S08 Social mobility
- S09 Vulnerable employment*

Environmental sustainability pillar

- S10 Stringency of environmental regulation[e]
- S11 Enforcement of environmental regulation[e]
- S12 Terrestrial biome protection*
- S13 No. of ratified international environmental treaties*
- S14 Agricultural water intensity*
- S15 CO_2 intensity* $_{(log)}$
- S16 Fish stocks overexploited* $_{(log)}$
- S17 Forest cover change*
- S18 Particulate matter (2.5) concentration*(log)
- S19 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, S04, and S05 are combined to form one single variable.

e Variables S10 and S11 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 coefficient

Measure of income inequality (0 = perfect equality; 100 = perfect inequality) | 2011 or most recent 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 percentages of total income received against the cumulative number 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 an index of 100 implies perfect inequality.

Sources: The World Bank, *World Development Indicators Online* (retrieved May 27, 2013); US Central Intelligence Agency, *The World Factbook* (retrieved June 6, 2013); national sources

S02 Youth unemployment

Percent of total unemployed youth to total labor force aged 15–24 | 2010 or most recent available

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

Sources: International Labour Organization, *Key Indicators of the Labour Markets Net* (retrieved June 5, 2013) ;The World Bank, *World Development Indicators Online* (retrieved May 27, 2013); national sources

S03 Access to sanitation

Percent of total population using improved sanitation facilities | 2011 or most recent available

Share 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.

Source: World Health Organization, *World Health Statistics 2013* (online database, retrieved June 5, 2013)

S04 Access to improved drinking water

Percent of the population with access to improved drinking water | 2011 or most recent available

Share 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 2013* (online database retrieved June 5, 2013)

S05 Accessibility of healthcare services

How accessible is healthcare in your country? [1 = limited, only the privileged have access; 7 = universal, all citizens have access to healthcare] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S06 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] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S07 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] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S08 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] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S09 Vulnerable employment

Proportion of own-account and contributing family workers in total employment | 2011 or most recent year available

Vulnerable employment refers to unpaid family workers and own-account workers as a percentage of total employment—that is, the share of own-account and contributing family workers in total employment. A *contributing family worker* is a person who is self-employed in a market-oriented establishment operated by a related person living in the same household, and who cannot be regarded as a partner because of 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 May 26, 2013)

S10 Stringency of environmental regulations

How would you assess the stringency of your country's environmental regulations? [1 = very lax ; 7 = among the world's most stringent] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S11 Enforcement of environmental regulations

How would you assess the enforcement of environmental regulations in your country? [1 = very lax ; 7 = among the world's most rigorous] | 2012-2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions

S12 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 CIESIN (Columbia University's Center for International Earth Science Information Network) by overlaying the protected area mask on terrestrial biome data developed by the World Wildlife Fund (WWF)'s Terrestrial Ecoregions 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, and 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 World Conservation Centre data

S13 No. of ratified international environmental treaties

Total number of ratified environmental treaties | 2012

This variable measures the total number of international treaties from a set of 25 for which a state is a participant. A state is acknowledged as a "participant" whenever its status for each treaty appears as "Ratified," "Accession," or "In Force." 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, as amended in 1962 and 1969, 1954 London; 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 Co-operation 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; the International Tropical Timber Agreement, 2006 Geneva.

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

S14 Agricultural water intensity

Agricultural water withdrawal as a percent of total renewable water resources | 2009 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 24, 2013)

S15 CO_2 intensity

CO_2 intensity (kg of CO_2 per kg of oil equivalent energy use) | 2009

Carbon dioxide (CO_2) emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include CO_2 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 May 27, 2013)

S16 Fish stocks overexploited

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

The See Around Us (SAU) project's Stock Status Plots (SSPs) are created in four steps (Kleisner and Pauly, 2011). In the first step, SAU defines a *stock* as a taxon (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 span of 10 years, and that 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 that meets the definition of a stock for a particular spatial area (e.g., exclusive economic zones, or EEZs). These 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; and (5) Rebuilding—after the year of peak catch and after the stock has collapsed, when catch has recovered to between 10 percent and 50 percent of the peak. In the third step, SAU graphs the number of stocks by status in a given year by tallying the number of stocks in a particular state and presenting these as percentages. In the final 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

S17 Forest cover change

Average percent change in forest area per year between 1990 and 2010 | 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 FAO data

S18 Particulate Matter (2.5) concentration

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

This indicator is based on satellite data that are then converted to ground-level concentrations using the GEOS-Chem global chemical transport model to account for the meteorological and chemical factors that influence the spatially and temporally varying relationship between column and surface concentrations. The 0.1 × 0.1 resolution aerosol optical depth (AOD) values for 2001–05 are derived from the NASA Terra MODIS and MISR sensors, averaged to get a six-year mean AOD for each grid cell, and then population-weighted to better represent human exposure by country. $PM_{2.5}$ concentrations were averaged over the period 2001–05 and the grid was resampled to match the Global Rural-Urban Mapping Project 1 kilometer population grid. The weighted average of the values in each grid cell was used to derive a country total 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

S19 Quality of 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] | 2012–2013 weighted average

Source: World Economic Forum, Executive Opinion Survey, 2012 and 2013 editions