

The Robeco Country Sustainability Framework

How we evaluate and integrate country sustainability performance into investment portfolios

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Preface

The sovereign debt market is one of the largest and most liquid in the world, with more than USD 60 trillion in assets. Despite its monumental size and significance for financing a nation's ongoing development, the integration of ESG factors in sovereign risk assessment has until now been largely neglected. However, sentiment and momentum are rapidly shifting as institutions, regulators, rating agencies and investors recognize how environmental, social and political-governance metrics impact a country's development and therefore the valuation of its sovereign bonds.

In an effort to continuously integrate sustainability considerations into a growing range of asset classes, Robeco has developed a comprehensive and systematic framework for determining country sustainability performance. Individual country performance is summarized into one score which is then used to rank countries for a peer-to-peer comparison.

Country sustainability analysis offers an alternative view into an economy's underlying change drivers and provides investors with insights into a country's strengths and weaknesses on a broad selection of environmental, social and governance indicators. It primarily focuses on mid-to long-term factors which are oftentimes insufficiently considered in traditional sovereign rating assessments. These factors have an indirect, and sometimes even direct, impact on a government's ability to implement reasonable economic policies and generate sufficient revenues ensuring its ability to service its debt.

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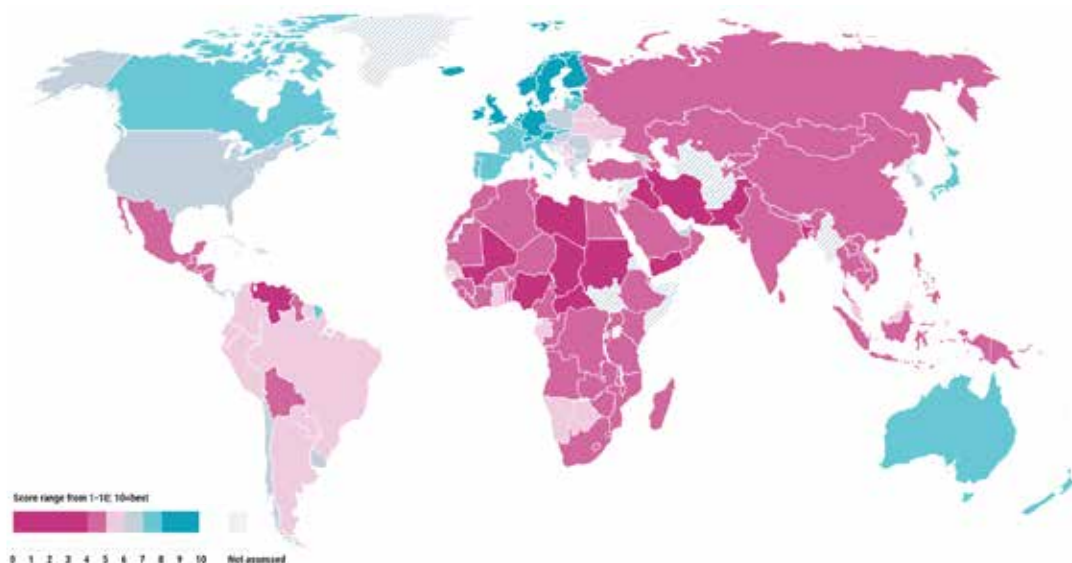
The Robeco Country Sustainability Ranking (CSR) is designed to complement traditional sovereign risk assessments carried out by rating agencies. As such, it forms the basis for incorporating environmental, social and governance risk analysis into the construction process for many of Robeco's sovereign debt portfolios, third-party sovereign bond indices, as well as the country exclusion list applied to all our investment strategies company-wide.

The CSR Framework – at a glance

For more than a decade Robeco has recognized the value of sustainability research for sovereign risk analysis. In 2010 we developed the Robeco Country Sustainability Ranking (CSR) – a tool that systematically aggregates large volumes of complex ESG data into one single country score.

The CSR Framework evaluates 150 countries – 23 developed and 127 emerging market & developing economies – on a broad range of environmental, social and governance (ESG) factors that Robeco considers to be key risk and return drivers relevant for investors.

Figure 1 | An overview of global country sustainability performance



Data note: Countries are color-coded according to their ESG scores.

Data source: Robeco, country sustainability scores as of October 2022.

Robeco applies the CSR tool internally to support macro-economic analysis, country allocations and other investment decisions of our strategies invested in government bonds. Moreover, it is used to construct external sovereign bond indices used by sustainable investors globally. In addition to complementing fundamental investment analysis, scores can also be used more broadly to inform engagement activities with governments as well as companies operating in particular jurisdictions.

The next section provides more detail on the underlying indicators, criteria and scoring calculations that lead to a final country sustainability score.

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CSR Methodology – a closer look

The country score is the final culmination of the analysis of 51 underlying indicators, each of which is based on various data series sourced from the world's foremost institutions for researching, financing, monitoring and advocating sustainable development in developed and emerging markets around the world. These include development banks, private institutions, NGOs, think tanks, rating agencies and universities. A complete list of data sources is provided in the Appendix.

Underlying indicators are grouped into 15 more generalized categories; four related to environmental, five social and six governance areas. The final country score is the weighted sum of all standardized indicator scores across environmental (weighted 30%), social (30%) and governance (40%) dimensions.

Underlying indicators are chosen based on their influence on a country's ongoing fiscal solvency and economic growth prospects. Research demonstrates that ESG indicators such as human rights, climate change, and political instability are economically important and material for sovereign debt pricing and can be leading indicators for changes in sovereign bond prices. Moreover, the selection and weighting of the individual indicators, criteria and dimensions that determine the final country score are based on expert judgement, evidence from external research, statistical analysis and peer comparisons.

WHAT GETS MEASURED



Environmental challenges pose a potential risk for investors, as environmental externalities can result in significant economic losses.

The erosion of natural habitats, extinction of native species, destruction of natural resources and other environmental damage from air and water pollution not only generate considerable fiscal costs, they weaken a country's future resilience and economic growth.

Adequate investments towards preventing environmental problems limit these threats and potential liabilities. Other important environmental risks relate to a country's exposure to natural hazards such as floods, hurricanes, earthquakes, or typhoons.

Moreover, climate change can contribute to falling incomes, poverty, involuntary migration, and socio-political conflicts. And energy policies can leave countries vulnerable to volatile price movements and/or supply shortages. We look at factors such as a country's adoption of renewable energy and changes in its carbon consumption and intensities. In addition to assessing the risks themselves, we specifically look for evidence that policies for mitigating such risks have been put into place.



A weak social climate dominated by labor unrest, extreme inequality, or other social tensions is another potential investment risk.

A delicate social climate can easily result in violent turmoil, disrupting important economic activity such as manufacturing or trade and/or paralyze policymaking. Strong social cohesion, on the other hand, supports orderly conflict resolution and facilitates the implementation of necessary reforms, thus contributing towards sustainable economic development.

A country's investments in developing and protecting its human capital also contributes to social stability and provides the building blocks for innovation, productivity and growth.

We look at key statistics on human capital development such as access to education, healthcare, jobs and social services as well as equity of income, opportunity and the protection of free speech and individual rights.

Moreover, the increased fiscal burden of aging populations is also considered within this dimension.



We integrate a broad range of data that consider a country's institutional framework, regulatory quality, rule of law, government efficiency, central bank independence and political stability, among other factors.

Civil liberties, internal conflicts and corruption also reflect a country's governance profile. The corruption level, for instance, shows the extent to which public power is exercised to protect the interests of a small group at the expense of the economy and society at large.

Although the availability of natural resources provides a country with a competitive advantage, historical evidence also shows that countries endowed with abundant natural resources often exhibit worse economic performance than countries with fewer resources but better governance. This suggests that a country's governance structure has a stronger and more direct influence on its economic well-being than other ESG factors.

The dominant weight of the governance dimension reflects the importance we assign to a country's institutional framework as a key precondition for the efficient and effective use of its natural resources and human capital.

Underlying indicators

For each country, numerous data series on a variety of ESG features are collected and summarized into 51 underlying ESG indicators. The sub-indicators underpin country performance across the ESG dimensions discussed above.

Of the 51 Indicators, more than half gauge a country's performance and possible risks related to the environment. Criteria measured include data related to biodiversity, climate & energy, water & waste and its vulnerability to climate change and natural hazards. For instance, a country's current and future greenhouse gas emissions as well as its share of renewables in its power mix are good indicators of its commitment to the energy transition and its overall resilience and preparedness.

Eleven indicators that include data on aging populations and labor force participation, education and human capital development, human rights and social inequalities as well as its degree of social instability underpin our analysis of a country's social standing. Sixteen sub-indicators that measure corruption, personal freedom, policymaking and policy-enforcing institutions, globalization and innovation as well as political risk and stability capture the strengths and weaknesses of a country's governance structures.

A complete description of the criteria is available in the Appendix.

Figure 2 | Robeco Country Sustainability Framework – score components

Indicators		Criteria	Weight	Dimensions	Weight	Country Score
For each country, numerous data series on a variety of ESG features are collected and summarized in >50 indicators. Each indicator gets a predefined weight and a relative score ranging from 1 to 10.		The indicators are aggregated to 15 criteria, whereby each criterion is also assigned a predefined weight.		Each dimension weight is the sum of the criteria weights within the respective dimension.		The Country Score is the weighted sum of all standardized indicator scores.
Biodiversity Intactness Index 2030 Projection Forest Cover Net Change Natural Resources Rent Red List Index	Ecological Deficit/Reserve Marine Protected Area Ocean Health Index Terrestrial Protected Area	Biodiversity	7.5%	Environmental	30%	Country Sustainability Score
Consumption CO2 per Capita GHG Emissions per GDP Consumption CO2 5-Yr p/C Change GHG Emissions 5-Yr p/GDP Change GHG p/C Reduction 2015-30	GHG Emissions per Capita Share of Renewables GHG Emissions 5-Yr p/C Change Share of Renewables 5-Yr Change GHG Emissions p/C Target 2030	Climate & energy	10%			
Integrated Water Management Water Stress Level Water Use Efficiency Waste Management	Wastewater Treatment Water Stress 2030 Projection	Water & waste	7.5%			
Climate Risk Index ND-GAIN Index	Natural Hazard Index	Environmental risk	5%			
Labor Force Participation Rate 55-64 Education Human Development Index	Old-age dependency ratio 25Y Projection Health	Aging Human development	7.5% 5%	Social	30%	
Global Rights Index	Human rights	Human & labor rights	7.5%			
Gender Inequality Index	GINI Coefficient	Inequality	5%			
Fragile States Index	Socio-economic vulnerability	Social unrest	5%			
Control of Corruption Globalization Index Government Effectiveness Rule of Law	Corruption Perception Index Global Innovation Index Regulatory quality	Corruption Globalization & innovation Institutions	7.5% 5% 10%	Governance	40%	
Freedom in the World	Voice & accountability	Personal freedom	5%			
Political Risk Rating ECR	Political Risk Rating PRS	Political risk	7.5%			
Human Hazard	Political stability/No violence	Political stability	5%			

Scoring Overview

In order to make the broad range of data meaningful and comparable, indicators, criteria and dimension values and their weighted averages are standardized in a series of steps using z-score distributions. The final country z-score is converted to a 1 to 10 scale using a statistical formula.

The selection of indicators is reviewed periodically, based on new evidence and/or availability of data; the weighting scheme is also reviewed periodically, based on the results of statistical analysis or newly gained empirical evidence and findings from academic research.

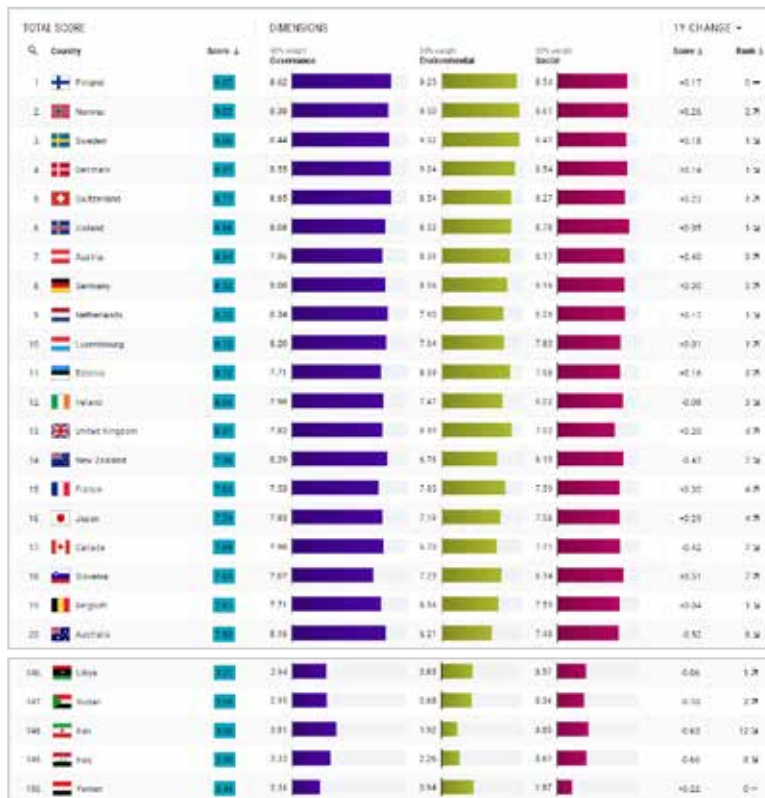
An illustrative example of the scoring process is provided in the Appendix.

Reporting the scores

Scores for the top twenty and bottom five sustainability performers as per October 2022 are shown below.

Superior ESG scores (8.0 and above) reflect countries with robust and well-balanced ESG profiles while the lowest performers are economically, socially, and politically fragile states.

Figure 3 | Top twenty and bottom five sustainability performers



Data source: Robeco, country sustainability scores as of October 2022.

The CSR – data-driven; powerfully predictive

It seems obvious that robust sustainability performance promotes economic growth, contributes to a healthy fiscal position and ultimately to a stronger, long-term sovereign credit profile. The opposite is also true; institutional failures, political upheavals, severe social disparities or pronounced inequalities undermine political and macroeconomic stability. Türkiye serves as an illustrative example.

Its CSR scores have spiraled downward since 2014, when its authoritative and nationalistic president, Recep Tayyip Erdogan, came to power. Adverse impacts are visible in Türkiye's weak political risk & stability, personal freedom, and institutions' scores, but also in human & labor rights marks within the social sphere (see Figure 4). By taking control of constitutional powers and interfering in economic policymaking, Erdogan has increasingly undermined state institutions and contributed to the economic woes and financial turbulence of recent years.

Figure 4 | Türkiye's ESG performance: back-sliding

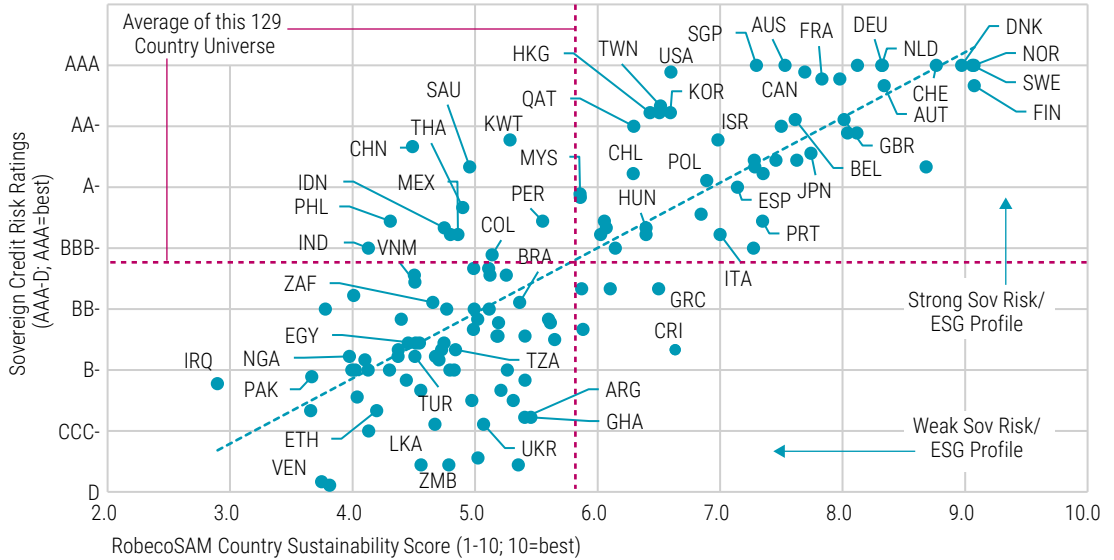


Data source: Robeco; data assessed as of October 2022

Data note: The chart displays Türkiye's ESG scores in 2014 compared to today (Q3 2022). Türkiye has lost ground across the aggregated ESG score, individual E, S, and G dimensions as well as in key governance criteria since Q3 2014.

Türkiye is just one in a universe of examples where a country's ESG profile and CSR scores helped to predict future turmoil and sovereign risks. Figure 5 illustrates this also on a broader sample of countries (n=129), where a fairly high positive correlation (0.81) between Robeco's country ESG scores and sovereign credit ratings is observed.

Figure 5 | Robeco country ESG scores reflective of sovereign credit risk ratings



Data source: Fitch, Moody's, Standard & Poor's, Robeco.

Data note: Sovereigns reflect the average of the three rating agencies; Sovereign credit risk ratings of 14 October 2022; Robeco country sustainability scores as of October 2022.

The ESG score to credit rating correlation is not perfect. Country ESG data may contain risks that are not always obvious (and probably not sufficiently captured) in traditional sovereign credit risk analyses which are still more focused on macroeconomic and debt-servicing variables. Hence, there will be differences in perceived risks between country sustainability performance and sovereign bond ratings.

For example, in Figure 5, the correlation between ESG scores and bond ratings is strongly positive. In the case of Greece, Italy, and Portugal, however, the sovereign credit ratings appear too conservative relative to their sustainability scores, suggesting the potential for an upgrade of sovereign ratings. On the other hand, China, India, and Saudi Arabia enjoy sovereign ratings that seem stronger than implied by their rather poor sustainability profiles.

Russia stands out among many recent examples of the risks of investing in a country with a weak and/or rapidly deteriorating ESG profile.

After its abrupt incursion into Ukraine, the big three sovereign ratings providers withdrew ratings on Russian sovereigns and individual Russian securities. As a result, Russia no longer appears on the chart. The country's average sovereign rating – marginally above BBB- before the start of the invasion in Ukraine – appeared slightly high relative to the country's ESG score at that time (4.71). Its rating has subsequently been downgraded to default.

CSR vs. credit default swaps

Given their usefulness as a signal for a country's overall creditworthiness, it would also follow that a country's ESG scores would have a strong negative correlation with a sovereign's probability of default as measured by credit default swaps (CDS).

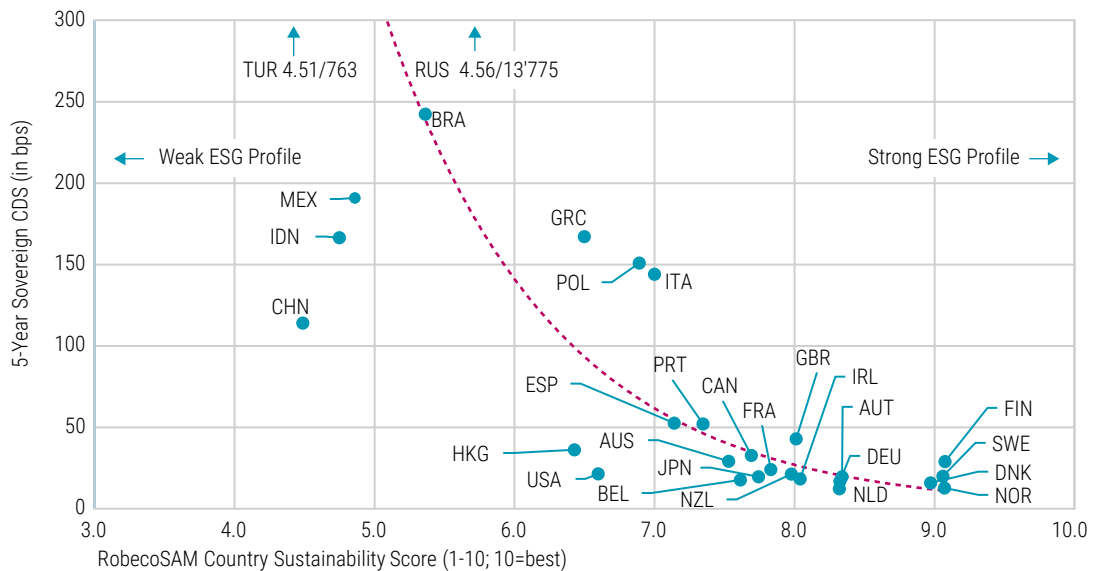
CDS can provide fixed income investors with protection against a country's default on its debt. In essence, CDS spreads serve as an insurance premium: the riskier the investment, the higher its spread. A high CSR score on the other hand represents lower sustainability risk and would therefore imply a lower insurance premium and a lower CDS spread.

Figure 6 displays the results of a regression analysis on sustainability scores (independent variable) and CDS spreads (dependent variable) which validates our assumption of the robust correlation between sustainability performance and measures of its potential risk of default. An upward or downward trend in the CSR scores signal potential moves in the pricing of sovereign credit risk.

As with credit ratings, the negative correlation between country ESG scores and CDS spreads is not perfect; some countries show lower CDS spreads relative to their ESG profile and vice-versa.

Still, the relevance of ESG factors for sovereign creditworthiness and their impact on sovereign bond and CDS spreads has been confirmed in several academic research papers that have used the Country Sustainability scores and rankings.

Figure 6 | Country ESG scores plotted against sovereign CDS



Data source: World Government Bonds, Robeco

Data note: The Robeco country sustainability scores as of October 2022. 5-year sovereign CDS spreads as of 16 October 2022.

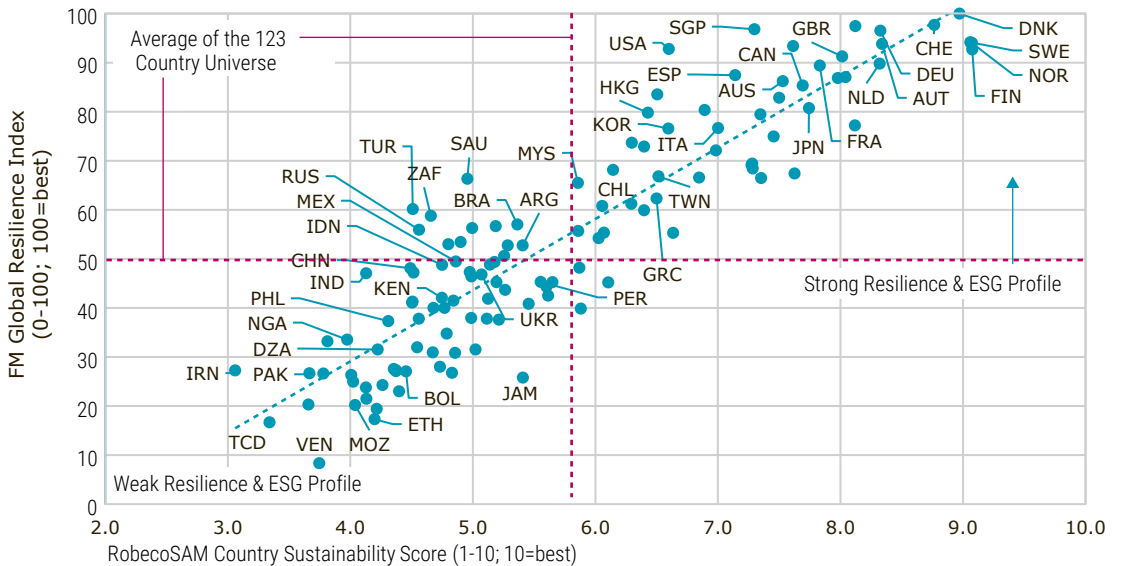
CSR-score alignment with country resilience

The devastating and far-reaching impacts of the Covid-19 pandemic clearly demonstrated the need for countries to build and strengthen their resiliency. However, such efforts cannot be limited to a strengthening of public health systems but must encompass a broader ESG spectrum. As the developments in recent years have shown, there is a need to reinforce the robustness of countries' policies and processes to better withstand future crises and shocks, particularly in the areas of governing institutions, disaster management & prevention and infrastructure at both the regional and national levels.

One interesting measure of robustness is the 2022 FM Global Resilience Index, an annual ranking of 130 countries and territories according to their vulnerability to disruptive events and ability to recover rapidly. FM Global's assessment tool aggregates 15 key drivers of resilience. These are equally weighted across three categories – economic, risk quality and supply chains. Major evaluation elements include climate change, political risk, and control of corruption – core factors that are also assessed in Robeco's country sustainability model.

Countries with high scores on the CSR also ranked high in terms of resilience as measured by the FM Global Resilience Index 2022 ($r=0.91$). While there are some notable exceptions, this broad alignment is expected, as countries with a stronger ESG profile are usually also less vulnerable to such disruptive events or are much better prepared to cope with their impacts (see Figure 7).

Figure 7 | Country ESG scores vs FM Global Resilience Index



Data source: FM Global, Robeco.

Data note: FM Global Resilience Index 2022; Robeco country sustainability scores as of October 2022.

Governance – revisions and maintenance

Recent revisions and ongoing maintenance

The world is rapidly changing. Latent risks are escalating and unforeseen risks are emerging at increasingly swift speeds. The CSR framework is reviewed on a continual basis to ensure results accurately reflect current realities and future risks. Recent enhancements include increasing the weight of environmental dimension (from 20 to 30%) along with the addition of datasets that more discretely measure climate change, biodiversity and water & waste metrics.

Social indicators were also replaced to reflect the increasing risks and opportunities associated with good social capital management. Financial development data have been removed from the dataset so as not to penalize poorer countries with more limited access to capital markets.

Changes will not only enhance our ability to comprehensively assess investment risks in sovereign bonds and other heavily macro-driven assets, they will also support our climate engagement activities with governments, with the goal of improving sustainable development in countries worldwide.

The framework's initial construction and subsequent revisions have been performed in consultation with internal and external experts from some of the world's foremost institutions for sustainable finance and economic development.

Operational oversight

Robeco's country sustainable investing experts and its ESG data scientists are primarily responsible for the ongoing operational oversight of the CSR framework. Each CSR score update involves a consistent end-to-end process whereby our team of experts source, validate, analyze/calculate and distribute the CSR data, scores and ranks for use by investment, engagement and other relevant teams. The team is also responsible for all interpretive analysis, commentary and published reports based on CSR scores that are reported to investors or published for broader consumption.

Moreover, in order to ensure the CSR's methodology and data remain state-of-the-art and materially relevant for investment portfolios, the CSR framework is governed by our Country Sustainability Committee comprising country sustainability specialists, representatives from our investment teams (including fixed income, equity and multi-assets), our SDG Strategist and the Head of Engagement. For CSR framework updates a broader group of internal stakeholders and external experts are consulted.

Conclusion

The CSR framework is built on Robeco's conviction that a country's ability to safeguard the needs of its future generations encompasses a broad range of environmental, social, economic and governance objectives. In addition to evaluating a country's access to and management of its natural resources such as carbon emissions and biodiversity, our methodology considers a number of social factors such as investments in education and health, and governance factors such as quality of institutions, political rights and civil liberties. Such factors are frequently overlooked by investors but have a direct impact on a country's economic performance and ultimately its long-term investment profile.

If not mitigated, ESG factors can adversely affect and further erode trust in country's social and institutional structures. If countries fail to adequately and proactively address long-term challenges in these areas, they can eventually develop into pressing (and even explosive) issues that require immediate action to prevent or contain damage to economic and political development.

The Robeco Country Sustainability Ranking is designed to complement traditional sovereign risk assessments carried out by rating agencies. As such, it forms the basis for incorporating environmental, social and governance risk analysis into the portfolio construction process of Robeco's sovereign debt as well as many other investment strategies that rely on macro-economic data at the country level. Moreover, it is also used to construct third-party sustainable sovereign bond indices, construct Robeco's country exclusion list, as well as for informing data-driven engagements with sovereign governments on ESG issues and needed reforms.

“Used in combination with traditional country risk analysis, the CSR can be a powerful tool for enhancing investment decisions and encouraging long-term sustainable development globally



Max Schieler
Senior Country
Sustainability Analyst



Johan Duyvesteyn
Portfolio Manager
Quantitative Fixed Income



Rikkert Scholten
Strategist
Global Macro Fixed Income

FAQs

Where to find more information?

For an overview of frequently asked questions please refer to Robeco's

SI Open Access Platform: www.robeco.com/docm/docu-qa-csr-framework.pdf

Appendix

I. COUNTRY ESG SCORES: CRITERIA DEFINITIONS

Environmental

Biodiversity Biodiversity is crucial for human well-being, livelihoods, economies, and the health of the planet as a whole. Biodiversity underpins human health, global nutrition, and food security as it provides the genetic resources for all crops, livestock and marine species harvested for food. It benefits business and the economy as a significant part of the world's GDP is dependent on nature. Biodiversity also acts as a buffer against natural disasters and mitigates climate change. A loss of biodiversity is therefore a key risk for the environment and for humanity.

Climate & energy This criterion provides an assessment of a country's performance in combating climate change and promoting renewable energies. Climate change is one of the biggest threats to the environment, to people and to the global economy. Warmer weather, rising sea levels and more frequent and extreme weather events are negatively affecting human health, livelihood, productivity, basic infrastructure, as well as various economic sectors such as agriculture, forestry, fishery, and tourism. In this way, climate change can contribute to falling incomes, spreading poverty, increasing involuntary migration, and even triggering socio-political conflicts, illustrating the need for decisive climate action.

Environmental risk All countries are exposed to and impacted by climate change, weather-related events and natural disasters such as cyclones, earthquakes, floods, forest fires, heat waves, hurricanes, storms, typhoons, volcanic eruptions etc. This criterion provides an assessment of the impact of such events both in terms of fatalities and economic losses. These events can lead to severe disruptions in the availability and production of goods and services, and thus result in adverse macroeconomic effects such as inflation, growth slowdown, export losses or debt servicing problems.

Water & waste Water is a vital natural resource that is needed for all life to exist. It is irreplaceable for use in agriculture, industrial, household, leisure, and environmental activities. However, water is also a scarce resource and widespread water stress undermines our basic human needs, contributes to food shortages, causes human displacement and leads to political instability. Water conservation and an effective water management is therefore an urgent need. Similarly important is a sparing use of other natural resources and a proper waste management.

Social

Aging A rapidly aging population poses significant challenges for an economy. It will cause a shrinking workforce, lead to a shortage of labor, a decline in productivity, a reduction of capital investments, and therefore reduce a country's economic growth potential. In addition, it is likely to result in lower income tax revenues, lead to increased government spending on health care and pensions, and thus cause a growing fiscal burden.

Human development Education and health are key pillars for a prosperous economy and society. The accumulation of human capital affects the level of skilled labor and thus the productive capacity of an economy. The better educated and healthier the population, the more innovative and productive the workforce. Access to effective education and health systems is therefore crucial for achieving and supporting a reasonable level of economic development, per capita income, and general well-being. Economic and human development are highly complementary – growth will enhance human development, and human development will promote growth.

Human & labor rights Human rights affect every area of human activity. They include civil and political rights, which refer to an individual's rights to participate in the political life. Freedom and participation rights also extend to the cultural, economic, and social spheres, including rights such as access to education, health, and labor. While the exact effect of basic human rights on economic growth is still a subject of dispute, freedom, participation, property rights as well as equal access to education and health appear to have a positive impact on growth. As an individual's opportunities grow and as they enjoy greater freedom, they will make better use of their capabilities and resources, creating a positive aggregate impact on the overall economy.

Inequality In general terms, there is a negative relationship between income and wealth inequality and economic growth. Extreme inequality can hamper consumption, investment in human capital, and may promote populist economic policies, hampering the economy over time. A second component of this criterion relates to gender inequality. Gender equality is when people of all gender identities have equal rights, responsibilities, and opportunities. Improving gender equality is also important for economic prosperity and gender-equal societies are usually healthier and safer.

Social unrest Research shows that the risk of violent protests, riots, and social unrest is higher in countries that are lagging in terms of economic development. Underdevelopment is more likely to cause social unrest, which tends to decline with ongoing economic growth and a growing level of happiness. Social conflict, in turn, can impose considerable economic and social costs, weaken state institutions, lead to greater uncertainty, cause political instability, and thus impair economic growth.

Governance

Corruption Corruption has many different shapes and can have various effects on the economy, the political environment as well as on society in general, as it lowers trust in the government, institutions, and the rule of law. In the economy, corruption can have negative implications on growth as it affects the business climate, causes higher costs, reduces investment and tax revenues, tilts public spending toward projects that are more susceptible to bribes, and leads to lower quality of public goods and services.

Globalization & innovation Even though research findings on the relationship between globalization and innovation are partly contradictory, there is quite some evidence for positive interlinkages. Globalization can spur innovation through the spread of knowledge and technology across borders. It increases competition and is forcing the adaptation of productivity-enhancing technologies, which can enhance a country's international competitiveness and economic prosperity. This in turn will allow further investments in human capital and modern infrastructure, thereby further advancing the innovation process.

Institutions Research shows that institutional organizations matter a great deal in determining a country's economic development and growth. Protection of property rights, effective law enforcement, efficient public administration, civil liberties, and a wide range of similar norms appear strongly correlated to a superior economic performance. This results from the positive impact of robust institutions, which tend to reduce transaction costs, lower risk and uncertainty, spur investment, and increase incomes.

Personal freedom The degree of human freedom and human rights has a vital role in economic prosperity. Countries that respect human freedom and rights create a predictable environment for economic actors and this, in turn, is positive for investment, productivity and the creation of welfare. With greater human and economic freedom, markets tend to perform more efficiently, and individual actors benefit from more opportunities, which also contributes to improving overall life satisfaction.

Political risk Political risk is broad, multi-faceted and includes features such as government politics, the political and electoral system, and the existence of checks and balances. It is obvious that there is a strong relationship between the political environment and economic development, as businesses, financial markets and the economy are impacted by a variety of political decisions, such as taxes, government spending, regulations, fiscal and monetary policy, exchange rate and investment controls, labor laws, trade policies and tariffs, and environmental laws.

Political stability This criterion measures the risk of sudden and disruptive political changes, or lingering instability. Instability can result from underlying socio-political tensions, abrupt and/or radical change in government, military coups, ethnic and religious conflicts, or foreign interference. Instability impairs economic policymaking, affects domestic and foreign investment, and can hurt economic activity in many other ways.

Appendix

II. COUNTRY SCORE CALCULATION

In order to make the broad range of distinct data comparable, data for each indicator is reviewed, transformed, where necessary, and then normalized into a z-score. Z-scores are a useful tool for standardizing disparate data points into a common, easy-to-read scale based on the dataset's average and a data point's standard deviation from that average within a normal distribution. As such, z-scores range between -3 to +3. Each time we aggregate data points at a new level – whether indicator, criteria, dimension, or total country score – we use a weighted average of the underlying z-scores to then again calculate a new z-score. This statistical step is necessary because the distribution of the average weighted z-scores is no longer a z-score in terms of the distribution of the outcome.

Without this step, the weights would no longer be properly reflected in the overall score. Please note: Final country scores are reported on a range from 1 to 10 (1=lowest, 10=highest). This final score is not simply a weighted average of the E, S, G dimension scores. It is rather the country level z-score obtained from the steps outlined above that has been converted into an easily recognizable scoring range using a statistical formula (see insert box below). The scoring process – from base level indicators to final country sustainability score – is shown below using Italy as an illustrative example

COUNTRY SCORE CALCULATION: EXAMPLE OF ITALY

Dimension level z-scores are derived by normalizing the weighted average of z-scores at the criteria level.

For Italy, the dimension level z-scores are Environmental: 0.758, Social: 1.171, and Governance: 0.828. Respective ESG scores are then converted into a scale from 1-10 using the formula below*. This results in the following scores for the E, S, and G dimension, Environmental 6.69, Social: 7.26, and Governance 6.74, Italy's reported scores as of October 2022.

To get from the dimension level z-scores to the total country score, we calculate the weighted average of the dimension z-scores: Environmental (0.758), Social (1.171), and Governance (0.828) using 30%, 30%, and 40% as the respective weights.

This yields a weighted average of 0.910. Then, we again perform the normalization using z-scores to arrive at 0.988 as the z-score for the total country score. In the final step, we convert the country z-score (0.988) into a scale from 1-10 again using the below formula which yields a total country score of 7 (rounded from 6.98) for Italy.

***Formula to convert country z-scores to a 1-10 scale = $1 + ((z\text{-score} + 3) * 1.5)$**

DATA PREPARATION

Step 1

Political Stability
Raw value: 0.578
Transformation:
not required

Human Hazard
Raw value: 0.1
Transformed:
-0.1 (raw value *-1)

INDICATOR LEVEL

Step 2

Political Stability
z-score of this metric:
0.724 (-3 to +3)

Human Hazard
z-score of this metric:
0.631 (-3 to +3)

CRITERIA LEVEL

Step 3

Political Stability
Weighted average of the two
indicator z-scores: 0.678

Step 4

Political Stability
New z-score for this
criterion: 0.887

Other governance criteria

Corruption
z-score: 0.608

Globalization & Innovation
z-score: 1.239

Institutions
z-score: 0.384

Personal Freedom
z-score: 1.152

Political Risk
z-score: 0.742

DIMENSION LEVEL

Step 5

Governance
Weighted average of the six
criteria z-scores: 0.759

Step 6

Governance
New z-score for this
dimension: 0.828

Other dimensions

Environmental
z-score: 0.758

Social
z-score: 1.171

COUNTRY LEVEL

Step 7

Country CSR Score
Weighted average of the
three dimension z-scores:
0.910

Step 8

Country CSR Score
New z-score for the country
total: 0.988

Step 9

Final Country CSR Score
Conversion of this
z-score into the final
country ESG score via
the following equation:
 $1 + ((z\text{-score} + 3) * 1.5) = 6.98$
= CSR score for Italy (Oct
2022)

Source: Robeco. Data as of October 2022.

Appendix

III. DATA SOURCES

1	Biodiversity	Biodiversity Intactness Index 2030 Projection	Natural History Museum, London	The Biodiversity Intactness Index
2		Ecological Deficit or Reserve	Global Footprint Network	Global Footprint Network
3		Forest cover Net Change	Global Forest Watch	Global Forest Watch (GFW)
4		Marine Protected Area	WDPA - World Database of Protected Areas	WDPA (World Database of Protected Areas)
5		Natural Resource Rent	World Bank	World Bank
6		Ocean Health Index	Ocean Health Index Team	Ocean Health Index team
7		Red List Index	ICUN/UN Statistics Division	UN Statistics Division
8		Terrestrial Protected Area	WDPA - World Database of Protected Areas	WDPA (World Database of Protected Areas)
9	Climate & energy	Consumption CO2 Emissions per Capita	Our World in Data/Global Carbon Project	Per capita consumption-based CO₂ emissions, 2019 (ourworldindata.org)
10		GHG Emissions per Capita	EDGAR	EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu)
11		GHG Emissions per GDP	EDGAR	EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu)
12		Share of Renewables to Energy Consumption	U.S. Energy Information Administration (EIA)	International - U.S. Energy Information Administration (EIA)
13		Consumption CO2 Emissions p/C 5-Yr Change	Our World in Data/Global Carbon Project	Per capita consumption-based CO₂ emissions, 2019 (ourworldindata.org)
14		GHG Emissions per Capita 5-Yr Change	EDGAR	EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu)
15		GHG Emissions per GDP 5-Yr Change	EDGAR	EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu)
16		Share of Ren/Energy Cons. 5-Yr Change	U.S. Energy Information Administration (EIA)	International - U.S. Energy Information Administration (EIA)
17		GHG Emissions p/C Reduction 2015-30	Climate Resource	NDCs - Climate Resource (climate-resource.com)
18		GHG Emissions p/C Target 2030	Climate Resource	NDCs - Climate Resource (climate-resource.com)
19	Water & waste	Integrated Water Management	UN Water - UNEP	Home SDG 6 Data
20		Wastewater Treatment	SEDAC - Socioeconomic Data & Applications Center	Environmental Performance Index (EPI) SEDAC (columbia.edu)
21		Water Stress Level	UN Water - FAO Aquastat	Home SDG 6 Data
22		Water Stress Projection 2030	World Resources Institute - Aqueduct	Data: Aqueduct Projected Water Stress Country Rankings. World Resources Institute (wri.org)
23		Water Use Efficiency	UN Water - FAO Aquastat	Home SDG 6 Data
24		Waste Management	SEDAC - Socioeconomic Data & Applications Center	Environmental Performance Index (EPI) SEDAC (columbia.edu)
25	Environmental risk	Climate Risk Index	Germanwatch	Globaler Klima-Risiko-Index 2021 Germanwatch e.V.
26		Natural Hazard Index	DRMKC - INFORM - European Commission	INFORM - Global, open-source risk assessment for humanitarian crises and disasters (europa.eu)
27		ND_GAIN Index	University of Notre Dame	Download Data // Notre Dame Global Adaptation Initiative // University of Notre Dame (nd.edu)
28	Aging	Labor Force Participation Rate 55-64	ILOSTAT - International Labour Organization	https://ilostat ilo org/data/
29		Old-Age Dependency Ratio 25-Year Projection	UN – Population Division	Population Division (un.org)

Source: Robeco, as per April 2023

30	Human development	Education	Legatum Institute	Rankings :: Legatum Prosperity Index 2023
31		Health	Legatum Institute	Rankings :: Legatum Prosperity Index 2023
32		Human Development Index	UNDP	Human Development Data Center Human Development Reports (undp.org)
33	Human & labour rights	Global Rights Index	ITUC - International Trade Union Confederation	ITUC GRI - Home (globalrightsindex.org)
34		Human Rights	Fund for Peace	Fragile States Index The Fund for Peace
35	Inequality	Gender Inequality Index	UNDP	Human Development Data Center Human Development Reports (undp.org)
36		GINI Coefficient	Our World in Data	Income inequality – Gini Index, 1981 to 2019 (ourworldindata.org)
37	Social unrest	Fragile States Index	Fund for Peace	Fragile States Index The Fund for Peace
38		Socio-Economic Vulnerability	DRMKC - INFORM - European Commission	INFORM - Global, open-source risk assessment for humanitarian crises and disasters (europa.eu)
39	Corruption	Control of Corruption	World Bank	WGI 2022 Interactive > Home (worldbank.org)
40		Corruption Perception Index	Transparency International	https://www.transparency.org/en/cpi/2022
41	Globalization & innovation	Globalization Index	KOF/ETHZ	KOF Globalisation Index – KOF Swiss Economic Institute ETH Zurich
42		Global Innovation Index	WIPO	Indicator Rankings & Analysis Global Innovation Index
43	Institutions	Government Effectiveness	World Bank - Worldwide Governance Indicators	WGI 2022 Interactive > Home (worldbank.org)
44		Regulatory Quality	World Bank - Worldwide Governance Indicators	WGI 2022 Interactive > Home (worldbank.org)
45		Rule of Law	World Bank - Worldwide Governance Indicators	WGI 2022 Interactive > Home (worldbank.org)
46	Personal freedom	Freedom in the World	Freedom House	Freedom in the World Freedom House
47		Voice & Accountability	World Bank - Worldwide Governance Indicators	WGI 2022 Interactive > Home (worldbank.org)
48	Political Risk	Political Risk Rating EIU	Economist Intelligence Unit	EIU subscription
49		Political Risk Rating PRS	PRS Group	PRS Group subscription
50	Political Stability	Human Hazard	DRMKC - INFORM - European Commission	INFORM - Global, open-source risk assessment for humanitarian crises and disasters (europa.eu)
51		Political Stability/No Violence	World Bank - Worldwide Governance Indicators	WGI 2022 Interactive > Home (worldbank.org)
* The bulk of the data is being obtained from CEIC Data				

Source: Robeco, as per April 2023

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