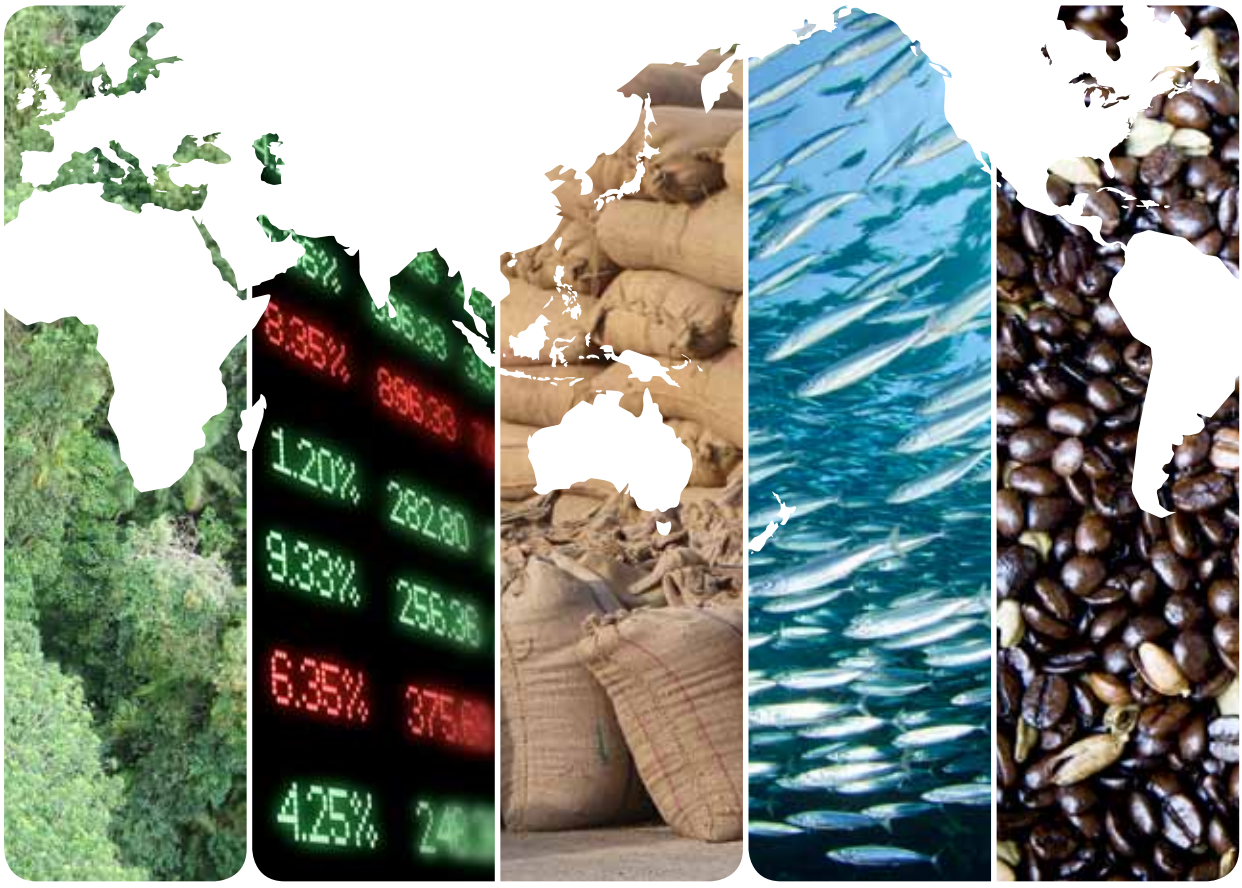
Phase 1 Report

UNEP

A New Angle on Sovereign Credit Risk

E-RISC: Environmental Risk Integration in Sovereign Credit Analysis



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Global Footprint Network is an international think tank working to advance sustainability through the use of the Ecological Footprint, a resource accounting tool that measures how much nature we have, how much we use and who uses what. Global Footprint Network coordinates research, develops methodological standards and releases annual data on the Ecological Footprint and biocapacity of 232 countries and humanity as a whole. By providing robust resource accounts to track the supply of and demand on ecological assets, Global Footprint Network equips decision-makers with the data they need to succeed in a world facing tightening ecological constraints.

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Key Messages

Sovereign bonds represent over 40 per cent of the global bond market, and are therefore one of the most important asset classes held by investors around the world. At the end of 2010, outstanding sovereign debt was equal to USD 41 trillion. Sovereign bonds have traditionally been considered a reliable and risk-free investment of choice by fund managers. Since 2008, this perception is being increasingly challenged.

A growing group of investors is recognising the need for a broader understanding of emerging risks in the bond markets. Furthermore, there is growing concern over the mounting threat of systemic risks outside of the financial system, notably environmental risk, which can impact multiple financial markets.

Natural resources, both renewable, biological resources such as food and fiber, and non-renewable resources such as fossil fuels, ores and minerals, are critical to each nation's economy. Yet, to date, risks stemming from renewable resources in particular are not well considered in sovereign credit risk assessments. As resource constraints tighten globally, countries that depend, in net terms, on levels of renewable natural resources and services beyond what their own ecosystems can provide may experience profound economic impacts as resources become more unreliable or costly.

Traditional sovereign credit risk analysis appears to inadequately reflect pressures from increasing global natural resource scarcity, environmental degradation and vulnerability to climate change impacts.

This report addresses how and why natural resource and environmental risks are becoming financially material for sovereign credit risk, not just in the medium term, but even in the short run. The E-RISC (Environmental Risk in Sovereign Credit analysis) methodology focuses on the development of metrics and methods for quantifying natural resource and environmental risks so they can be incorporated into sovereign credit risk assessments. This initiative focused on one key piece: to demonstrate the potential materiality of natural resource and environmental risks in the context of sovereign credit risk analysis, which can affect the underlying value of sovereign bonds.

The methodology relies on the Ecological Footprint and biocapacity metrics to assess a country's resource situation in order to identify how these risks might affect sovereign credit risk. The traditional focus on renewable biological resources by Global Footprint Network (such as fisheries, forests, cropland and grazing land) is supplemented with data on non-renewable natural resources including fossil fuels, metals and minerals to provide a more comprehensive definition of natural resources.

The method and metrics developed in the E-RISC project lay the foundations for enhanced analytics that can account for the growing materiality of natural resource constraints for sovereign credit risk.

Five countries – Brazil, France, India, Japan and Turkey – were analysed, based on consultations with the participating financial institutions. The methodology should be regarded as a first step to link natural resource risks to sovereign credit risk, not a final product. Methodological enhancements of the E-RISC approach applied to a larger number of countries will provide a more comprehensive overview. The first phase of the E-RISC project provide the following results:

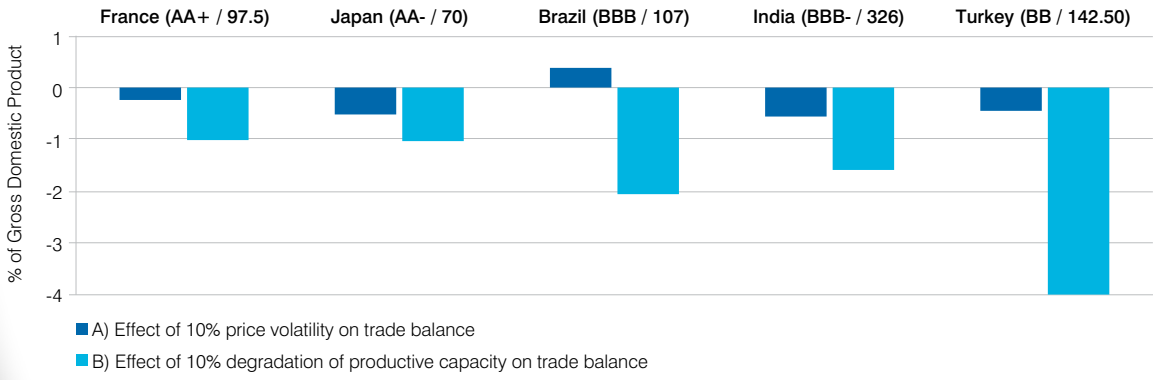
A 10 per cent variation in commodity prices can lead to changes in a country's trade balance equivalent to between **0.2 and 0.5 per cent of a nation's GDP**. Given the recent fluctuations in commodity prices investors should take note of these issues in the short term (0 – 5 years).

A 10 per cent reduction in the productive capacity of renewable, biological resources, and assuming that consumption levels remain the same, could lead to a reduction in trade balance equivalent between **1 and over 4 per cent of a nation's GDP**. Given the growing body of scientific evidence on ecosystem degradation and climate change impacts, governments, bondholders and credit rating agencies should take note of these issues in the **short to medium term**.

Results of the E-RISC project show risks related to natural resource constraints and their broader environmental consequences can exhibit significant risks for the five countries studied over both **short** (0 – 5 years) to **medium-term** (5 -10 years) time frames. This contradicts the conventional belief that natural resources risks are only relevant in the long term.

Countries have quite distinct environmental and natural resource risk profiles. Resource dependence and exposure to price volatility vary by factors of more than two, whereas exposure to degradation effects varies by more than fourfold among the five case study countries analysed. Furthermore there is no correlation between resource exposure and sovereign credit ratings or credit default swaps.

Fixed income investors, credit rating agencies and governments are encouraged to identify not only how natural resource and environmental risks can be integrated into sovereign risk models and but also which solutions can address them.



The X-axis shows sovereign credit ratings (foreign currency) for five countries (source: S&P) and sovereign credit default swaps (source: Markit). Sources for data shown on Y-axis: A) Global Footprint Network calculations based on UNCTAD data for 2010; B) Global Footprint Network calculations

Foreword

Achim Steiner
UN Under-Secretary General and UNEP Executive Director

Rising natural resource prices and increasing levels of ecosystem degradation alongside the impacts of climate change are already affecting countries in both the developing and the developed world alike. These issues are relevant not just to Ministries of Environment but also to Ministries of Trade, Economics and Finance as well as Central Banks. Indeed a country's natural assets are often fundamental to its economic growth, stability and long term sustainability since many sectors are directly or indirectly dependent on these resources such as forestry, pulp and paper, energy, agriculture, pharmaceuticals and chemicals.

The E-RISC report is the first output of a joint project between UNEP-Finance Initiative (UNEP-FI), Global Footprint Network and a number of financial institutions. It represents a first start at mapping out the connections between natural resource risks, the broader environmental implications and the economic and financial materiality for sovereign credit risk. Crucially, the report also provides a first attempt on how such natural resource criteria can be factored in sovereign credit risk models and thus in the selection and weighting of sovereign bonds and sovereign credit ratings.

The ERISC project assesses how growing natural resource scarcity and environmental degradation can impact a country's economy, and in turn what financial risks these pose in the context of sovereign credit ratings. Case studies are highlighted for nations including Brazil, France, India, Turkey and Japan. UNEP continues to press for enhanced understanding of and action on environmental challenges and opportunities in respect to both governments and the private sector initiatives such as the inclusive Green Economy, The Economics of Ecosystems and Biodiversity and the Natural Capital Declaration.

The increasing interconnectivity of challenges and issues in the 21st century require a far more intelligent, sophisticated and joined up approach than in the past. The relevance of collaborative projects such as E-RISC become thus ever more relevant as does the need to develop more knowledge, data and methodologies to mainstream the integration of environmental criteria in different asset classes such as bonds, equities, loans and insurance products.

Susan Burns
Founder and Senior Vice-President Global Footprint Network

More and more countries depend on a level of resource demand that exceeds what their own ecosystems can provide. This trend is tightening the global competition for the planet's limited resources – and puts at risk the strengths of all the economies subject to this competition. This new phenomenon has turned into a more significant factor of economic performance, yet its influence is still underestimated. Under-appreciating this factor is risky both for sovereign bond investors as well as for the countries issuing such bonds. A more accurate description of economic reality is therefore in the interest of all, and essential for generating stable, prosperous outcomes.

That is why we are so pleased about our partnership with the United Nations Environment Programme's Finance Initiative. It has been a thrill to jointly conceive the project, develop the concepts, gather a significant number of financial institutions and solicit their advice, test the initial findings with these financial institutions, and finally produce this report. There are ample opportunities to go deeper.

Our first step was to demonstrate that resource constraints have become a material and significant factor of economic performance and in doing so, illustrate exactly what pathways link ecological and economic risk. Finally, we next laid out how these risks can be quantified so they can inform investors and governments alike about how to mitigate, or even better, avoid those risks.

Let me extend our warmest thanks to UNEP-FI for its dedication to the project, and also to the 15 financial institutions that showed early interest, participated in the workshops, and rolled up their sleeves to contribute to and improve this report. I hope you all share with me that the work we have undertaken this year has been well worth the effort. We look forward to taking this work out to the broader financial community and to hearing from you.

Contents

1. Introduction

Over the past 12 months the sovereign debt of the USA, as well as Spain, Greece, Portugal and other nations primarily in the Eurozone, were downgraded. Sovereign bonds have generally been considered safe securities, especially of OECD countries, but that picture is now quickly changing. Recent reports have shown the recent trends in rising costs of key commodities,[1] reversing more than two decades of stable or falling prices. Countries are therefore seeing their import bills for both biological resources (fish, timber, wheat and other soft commodities) and fossil fuels rise. While the drivers of these increases are complex, it is clear that ecosystems and the services they provide such as timber, fish, crops, livestock and CO_2 sequestration, underpin our economies in a significant way. It is therefore vitally important to understand how changes in trends in the use and availability of natural resources can affect national economic health in the 21st century. Do capital markets sufficiently account for risks associated with changes in ecosystems and the availability of natural resources? Are such factors reflected in the assessment of fixed income securities with medium- to long-term maturities? These questions are at the heart of the E-RISC project.

A Growing Asset Bubble? Sovereign bonds typically represent a significant percentage of any given investment portfolio[2] and have traditionally been viewed by investment managers as a safe and reliable asset. Indeed new financial regulations on capital adequacy requirements for banks (Basel III) and insurers (Solvency II)[3] have classed sovereign debt as risk free. Thus in the quest to strengthen bank capital ratios and minimise over-leverage through risky assets, these new regulations are encouraging or even requiring investors to hold an increased level of triple-A rated sovereign debt as part of the investment portfolio.[4] In light of the recent downgrades and potential defaults, many investors worry about sovereign bonds being the next potential asset bubble,[5] since recent financial headlines have shown exposure of banks and investors to sovereign debt can hold significant risk.[6]

Understanding Systemic Risk: The on-going sovereign debt crisis in Europe and the challenges facing the United States government have illuminated the need for greater comprehensiveness in the accounting of assets and liabilities at the national level. There is however increasing concern from some investors on the understanding of systemic risks *outside* of the financial system. A small but growing group of investors are looking beyond economic and fiscal issues, to better understand how environmental, social and governance risks might impact sovereign credit risk over the short, medium and long term.[7] To date, however, there has been less advancement on environmental risk indicators than on social, political and governance factors in sovereign credit risk assessment.

Emerging Risk Drivers: Demand for renewable, biological natural resources and services now exceed the planet's ability to provide them by one and a half times and rising.[8] As many countries grow more dependent on resources and services they cannot provide from within their own borders, their import bills for both biological and non-renewable resources rise. This signals more competition for the planet's limited resource capacity, with potentially negative consequences[9] for economic performance and fiscal revenue. The result is that resource constraints and associated prices will become an ever more significant determinant of economic performance, and therefore, credit risk.

E-RISC: The consequences of natural resource depletion and environmental degradation[10] have accompanied a growing awareness of the limitations of traditional financial risk frameworks. The recent financial crisis and government debt crisis has provided a window of opportunity for projects such as E-RISC(Environmental Risk in Sovereign Credit analysis) to question former assumptions on the adequacy of conventional rating and risk assessment methodologies. E-RISC attempts to demonstrate the materiality of environmental risk, making the connections between environmental risk and core economic or financial indicators quantifiable. The overall aim is to allow for the incorporation of these factors into bond risk analysis, thereby allowing for the improvement of assessment tools and ratings.

2. Understanding Sovereign Credit Risk Assessment

Sovereign bonds are securities issued by a central government to raise money on capital markets. They represent over 40 per cent of the global bond market, and are therefore one of the most important asset classes held by investors around the world.[11] Outstanding sovereign debt was valued at USD 41 trillion at the end of 2010,[12] making the sovereign bond market nearly as big as the global equity market.[i]

Key players in sovereign bond markets are the issuers (governments), central banks, bondholders (sovereign wealth funds, pension funds, insurance companies and other institutional investors as well as banks), credit rating agencies (CRAs) and financial advisers. Sovereign credit worthiness is a measure of the ability and willingness of a country to pay back its debt. Simply put, debt repayment requires sustainable revenue for governments through taxes, royalties and other types of income, which in turn require stable and sustainable economic activities.[13] Conventional risk factors for assessing sovereign credit worthiness are shown in Figure 1.

FIGURE 1:
Conventional factors and measures of sovereign credit worthiness currently used by credit ratings agencies and investment analysts.[14]

These risk factors are further described below:

- **Economic development:** Economic structure and growth prospects (GDP, GDP per capita, Inflation)
- **Government debt burden:** Debt burden & structure, funding access (total debt as percentage of GDP, interest payments, and average debt maturity).
- **Budgetary Performance:** Fiscal performance and fiscal flexibility, long-term fiscal trends and vulnerabilities (budget deficit as percentage of GDP).
- **Foreign liquidity & balance of trade:** External liquidity & external indebtedness (foreign debt as percentage of GDP, foreign currency and reserves, trade deficit/surplus, dependence on a single commodity).
- **Monetary flexibility:** Ability and effectiveness of using monetary policy to address domestic economic stresses; credibility (inflation trends).
- **Institutional & Political Factors:** Institutional effectiveness, reliability & transparency; political risks; ability to respond to economic or political shocks.

Given that economic sectors are directly or indirectly dependent on renewable natural resources such as the forest products, energy, agriculture, pharmaceutical and chemical industries, there is a clear need to better understand, measure and value how the underlying natural capital contributes to a nation's economy. This is particularly important in countries where natural resource security issues have the potential to disrupt existing trading arrangements.

[i] Total market capitalisation of USD 55 trillion at the end of 2010.

3. Integrating Environmental Factors in Sovereign Credit Risk

In recent years, progress has been made in comparing the financial performance of 'conventional' equity portfolios with portfolios in which environmental, social and governance (ESG) factors have been part of the screening and selection process.[15] However, methods and metrics for linking ESG materiality to other asset classes, most notably fixed income assets, lag behind.

Fixed income represents a major asset class with the global bond market valued at around USD 95 trillion[ii] that, to date, has received little attention in terms of ESG materiality, partly because:

- **Bonds have traditionally been considered a much safer, though less attractive and less volatile, return on investment than equities.[16]**
- **Absolute priority rule means that bondholders must be paid in full before other creditors, like equity holders, can get their money back.**
- **Bondholders do not engage with debtors in the same manner as stock holders, who can exercise active ownership.**

Credit Rating Agencies: While some social and governance factors are included in sovereign risk assessment (notably institutional and political factors), environmental risk exposure focuses mainly on accounting for the effects of recurrent natural hazards and economic reliance on single commodities.[17] However, there remains a paucity of publicly available information and analysis on other forms of environmental risk on which this report sheds sharper light.[18]

Asset owners & investment managers: Some investors use quantitative ESG data at an early stage or 'contextualisation' phase, disconnecting the analysis from the core financial analysis, and instead using it to provide context to the rating. For example, Bank Sarasin uses resource-based metrics such as the Ecological Footprint as a quantitative metric for assessing country level sustainability performance.[19] Others use qualitative ESG analysis in the pre-screening process (e.g. filtering out countries that produce certain types of weapons) or to reduce exposure to a certain type of sovereign bond. See Box I how SNS Asset Management integrates ESG information in government bonds.

BOX I:
SNS Asset Management: Accounting for ESG in government bonds

SNS AM applies a two-layered approach to responsible investment in government bonds. First, countries are examined on potential violations of SNS AM's weapon criterion. Then, SNS AM excludes countries from investment in their (central government's) bonds when there is a high risk of (future) involvement in serious and systematic human and labour rights violations or corruption and/or serious, irreversible environmental damage. SNS tries to establish how far the (central) government can be held accountable for any controversies, and make a distinction between allegations and proven facts (using external data providers, jurisprudence, and reports of international institutions, e.g. United Nations, World Bank and International Labour Organisation). SNS realises that this approach deserves further work toward an integration of the ESG analysis deeply into the investment decision-making and portfolio construction process.

Information providers & ESG raters: A growing number of banks and investors are buying ratings or ESG data from information providers[20] to supplement their own sovereign credit risk analysis.[21] Many ESG specialists compare ESG performance with credit ratings of major CRAs,[22] showing correlations between credit ratings and certain ESG indicators. These forms of analysis have added a valuable new layer of information to traditional analysis. However, it means that ESG ratings tend not to be explicitly linked to the economic, fiscal and political factors that make up a sovereign's credit rating.

Natural resource and environmental-based externalities are rarely analysed, valued or priced within sovereign credit risk analysis. However, bonds are not shielded from the impact of resource constraints and environmental degradation. Together with increasing volatility in commodity prices[23] and increasing human consumption of natural resources, these issues are gradually being recognised as having the potential to affect the risk profile of bonds.

[ii] Of which sovereign bonds have been estimated at over 40 trillion USD.

BOX II:
Key Terms

The E-RISC project broadly aims to demonstrate the materiality of natural resource risks and their broader environmental consequences in the context of sovereign credit worthiness.

Natural Resource Risks: The project aims to demonstrate the materiality of natural resource constraints (both renewable and non-renewable) for sovereign credit risk. For renewable resources, the project utilises the Ecological Footprint methodology to track at a country's demand on and availability of biologically productive surfaces that can provide resources and ecosystem services ("biocapacity"). The Ecological Footprint is complemented by data on fossil fuels, metals and minerals to give a more complete picture of natural resource risks.

Environmental Degradation: Overusing natural resources depletes the productive capacity of ecological assets, such as forests and fisheries. In the report, this overuse and depletion of natural resources is referred to as environmental degradation.

Sovereign credit ratings: The opinion of a credit rating agency or internal risk assessment of a financial institution of the future ability and willingness of sovereign governments to service and repay their debt obligations in full and on time.[24]

Ecological Footprint: A population's demand on nature, measured in terms of the biologically productive land and marine area required to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. The national calculations presented here include food, fibre and timber, urban space, and area required for sequestering carbon dioxide emissions from fossil fuel.

Biocapacity (or biological capacity)**:** The capacity of ecosystems to provide services to people including production of useful biological materials (food, fibre and timber) and absorption of waste materials generated by humans, using current management schemes and extraction technologies. "Useful biological materials" are defined as those demanded by the human economy. Biocapacity is usually expressed in global hectares – biologically productive hectares with world-average productivity. Like two sides of a financial balance sheet, a country's Ecological Footprint can be compared with its biocapacity.

Natural Capital: The earth's natural assets (soil, air, water, flora and fauna), and the ecosystem services resulting from them. Natural Capital represents a flow of ecosystem services, including soil regeneration, air regulation, water purification, habitat for species, fisheries, crops, carbon sequestration, etc..[25] Biocapacity is a subset of Natural Capital, representing the flow of biological resources from fisheries, forests, and cropland, as well as waste absorption such as the service of CO_2 absorption provided by forests. The methodology used for the E-RISC project complements biocapacity data with data on fossil fuels, metals and minerals, encompassing more elements of Natural Capital. Even so, there are important components of Natural Capital that are not covered by this project such as climate regulation, species diversity, water filtration and others.

Bond Markets: Financial market for participants to issue new debt (primary market) or buy and sell debt securities (secondary market), in the form of bonds. The bond market offers a mechanism to provide long term funding of public and private expenditures. The bond market is comprised of corporate markets, government and agency markets and municipal markets as well as asset-backed (including mortgage-backed and collateralised debt obligation) markets and funding markets.[26]

Fixed Income Investments: An investment that provides a return in the form of periodic payments and the eventual return of principal at maturity.

Sovereign/Government bonds: A debt security issued by a national government within a given country and denominated in either the country's own currency or a foreign currency. While the terms are used interchangeably in the market, for the purposes of this report, the term 'sovereign bond' shall be used.

4. E-RISC: Bringing Natural Resource Risks into Sovereign Credit Risk

Demonstrating the relevance of natural resource and environmental risk to a nation's economy requires a direct and financially material linkage to be made between a country's use and dependency on natural resources and its macroeconomic and fiscal performance. The E-RISC project attempts to demonstrate this link and adds value to sovereign bond investors, analysts, information providers and rating agencies in a number of ways.

Linking ecosystem degradation to changes in the value of securities. Studies such as TEEB (The Economics of Ecosystems and Biodiversity)[27, 28] and the Millennium Ecosystem Assessment,[29] amongst other scientific efforts, articles and reports, have made significant contributions outlining to the broader public the importance of ecosystems and the products and services it provides to humans, whether tangible or intangible. However, such reports did not seek to provide a systematic case to bond and equity investors on how changes in ecosystems can affect the performance of bonds and equities. The E-RISC project attempts to fill this gap.

Providing integration in addition to correlation. To date, the majority of ESG analysis focuses on correlations between ESG performance and country ratings. This has been a vital first step and provides valuable information on comparative performance of sovereigns across a range of ESG issues. However, it may not provide the in depth information that is necessary to understand how such factors affect key economic indicators. The next step is now required in which ESG criteria can be integrated into the conventional risk assessment frameworks used by asset owners, asset managers and CRAs.

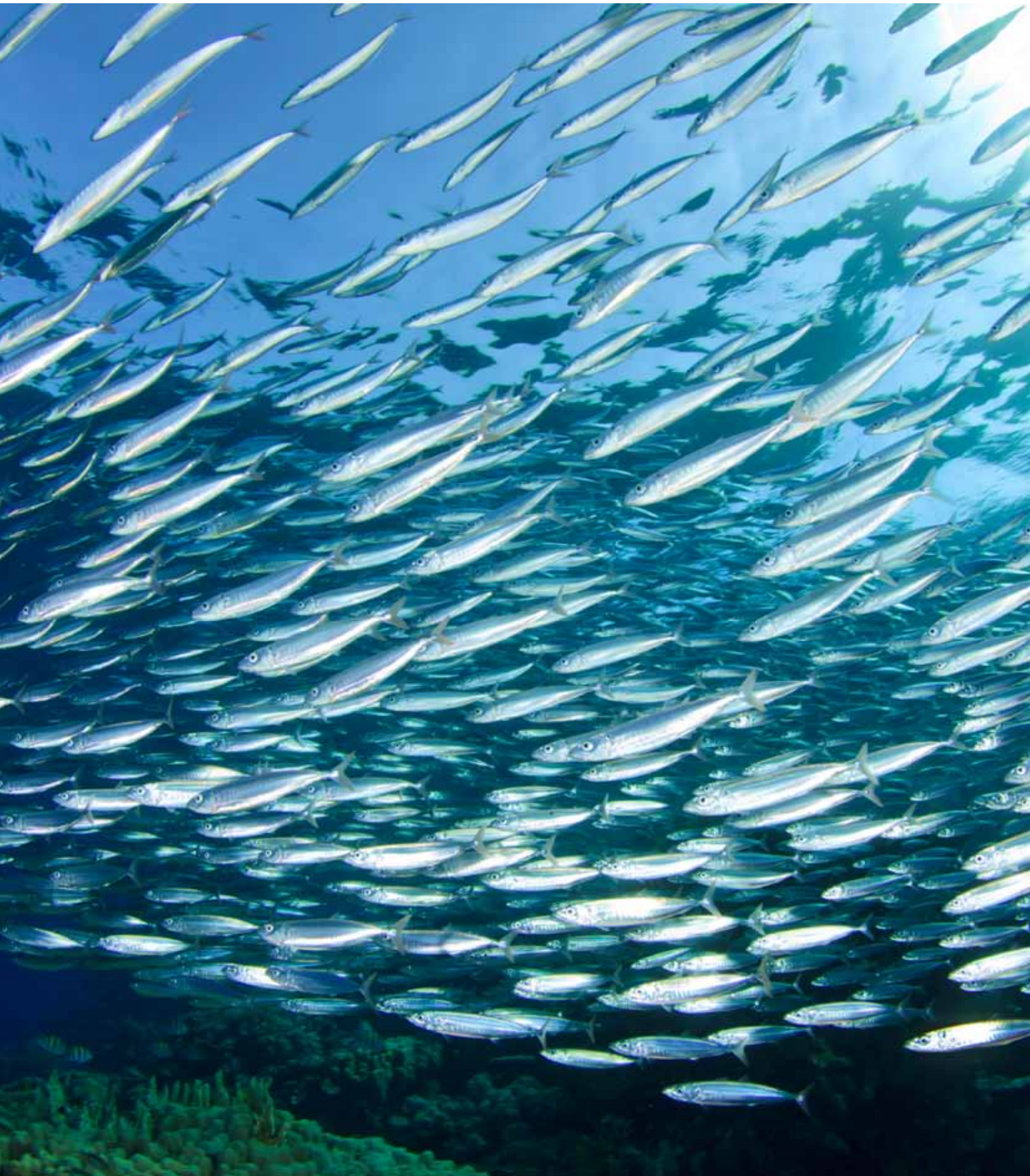
Focussing on the "E" factor in ESG analysis that has largely been overlooked by investors. Some progress has been made to embed governance and social factors in bond analysis. However, the complexity of environmental data has limited its ability to be systematically incorporated into risk frameworks and consistently applied across an investment universe. Furthermore, environmental risk has been perceived by bond investors as having a low level of materiality. The E-RISC project aims to fill this void approaching sovereign credit risk from a perspective that to date has been largely overlooked by investors and rating specialists: natural resource risks and their environmental consequences.

The E-RISC report, therefore, aims to create a deeper understanding of natural resource use patterns and their economic implications for sovereign credit risk. It provides fixed income investors the opportunity of integrating these risks among the criteria used in selecting and weighing sovereign bonds in their portfolios. Doing so will more accurately reflect the risk profile of sovereign fixed income investments in a more resource-scarce 21st century. Improving the understanding of countries' natural resource balance and the ability to measure it also provides governments with information and guidance to manage natural resource challenges at the country level.

BOX III:
Consistency and Coverage for Financial Risk Methodologies

A major challenge in ESG integration is the complexity of finding environmental data that can consistently be applied across an investment universe. Rating agencies and financial institutions are obliged to ensure consistency, traceability, coverage and the standardised application of data across all countries, yet there remains patchy coverage of many ESG indicators. The Ecological Footprint methodology provides a standardised, peer-reviewed methodology that through the National Footprint Accounts tracks human demand on and availability of biocapacity for over 230 nations over time. These accounts are based on approximately 6,000 data points per country per year, beginning in 1961. Developing analysis and metrics based on the standardised methodology of the Ecological Footprint enables consistency and coverage across all countries included in major Credit Rating Agencies' universes – a key requirement for ultimate integration into standard methodologies for evaluating country risk.

5. The Ecological Footprint and Natural Resource Risks



The aim of the E-RISC methodology is to demonstrate the materiality of natural resource constraints and environmental degradation in relation to sovereign credit risk. The Ecological Footprint, a comprehensive resource accounting tool, provides a resource balance sheet for countries by comparing a country's demand on biocapacity with its supply. This resource balance and trends over time are key elements that will define much of the nature and magnitude of the natural resource-related risks that a country faces.

To compliment the Ecological Footprint data the E-RISC methodology also incorporates data on fossil fuels, metals and minerals, which are not measured directly by the Ecological Footprint method.

The Ecological Footprint measures the area of biologically productive land and water required to support the activities of a population. It covers six resource categories, which comprise the components of the Ecological Footprint and biocapacity calculations: cropland, grazing land, forest land, fishing grounds, carbon Footprint (the land required to absorb CO_2), and built-up land (Figure 2). These different land types and uses are expressed in a common unit, the global hectare, to enable aggregation and comparison. A global hectare is a biologically productive hectare with world average productivity in a given year.

At the global level, humanity's Ecological Footprint overtook available biocapacity in the early 1970s and it now takes the planet 18 months to generate the biological resources and services (namely carbon absorption) that are consumed in one year.

FIGURE 2:
The Components of the Ecological Footprint

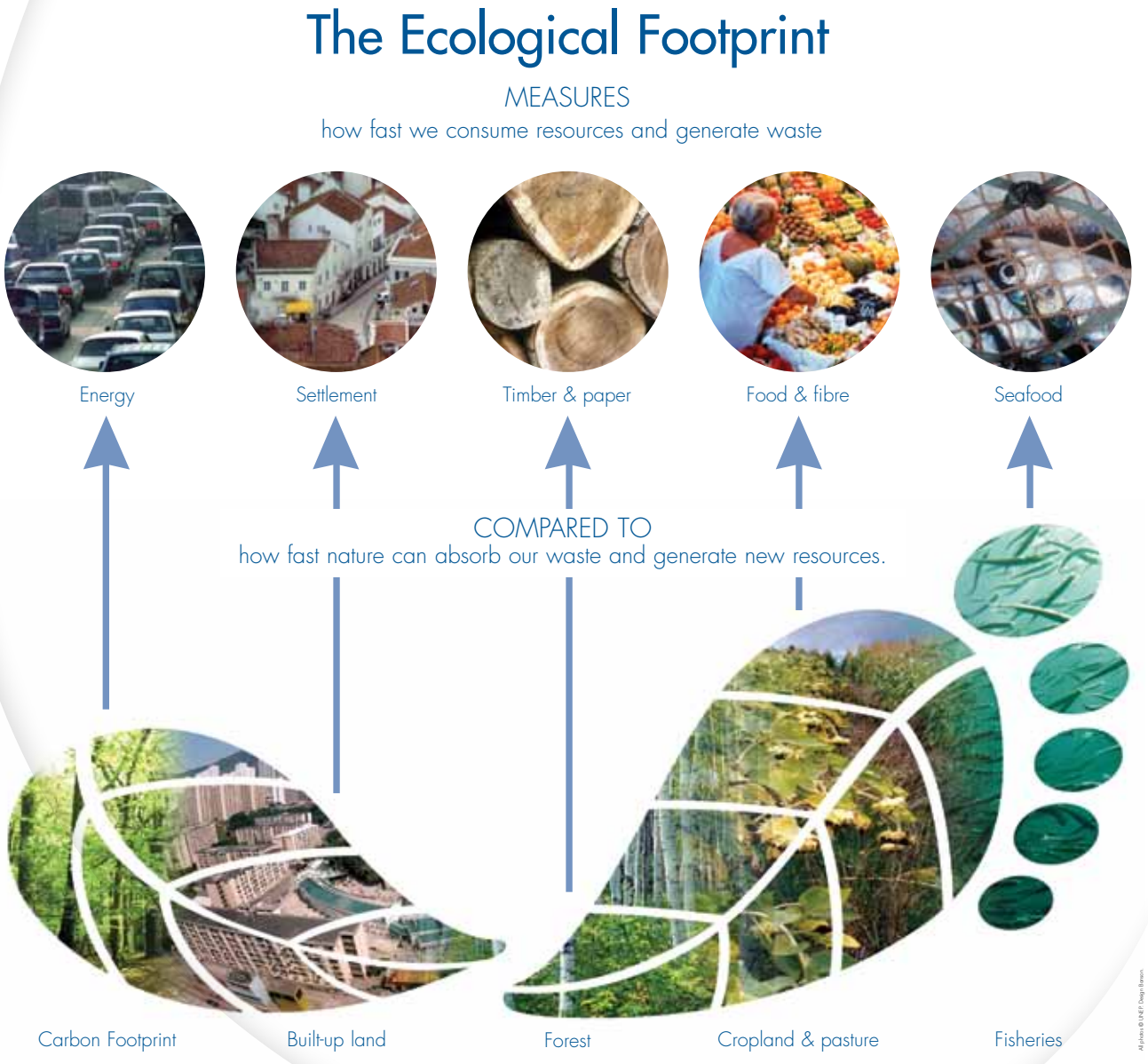


FIGURE 3:
A country's Footprint of consumption is calculated by summing the Footprint of production and the Footprint of imports and subtracting the Footprint of exports.

Ecological Footprint of Consumption

The Ecological Footprint of consumption indicates the consumption of biocapacity by a country's inhabitants.

In order to assess the total domestic demand for resources and ecological services of a population, we use the Ecological Footprint of consumption (EFc). EFc accounts for both the export of national resources and ecological services for use in other countries, and the import of resources and ecological services for domestic consumption.

EFc is most amenable to change by individuals through changes in their consumption behavior.

Ecological Footprint of Production

The Ecological Footprint of production indicates the consumption of biocapacity resulting from production processes within a given geographic area, such as a country or region.

It is the sum of all the bioproductive areas within a country necessary for supporting the actual harvest of primary products (cropland, pasture land, forestland and fishing grounds), the country's built-up area (roads, factories, cities), and the area needed to absorb all fossil fuel carbon emissions generated within the country.

This measure mirrors the gross domestic product (GDP), which represents the sum of the values of all goods and services produced within a country's borders.

Net Ecological Footprint of Trade

The Ecological Footprint of imports and exports indicate the use of biocapacity within international trade.

Embedded in trade between countries is a use of biocapacity, the net Ecological Footprint of trade (the Ecological Footprint of imports minus the Ecological Footprint of exports). If the Ecological Footprint embodied in exports is higher than that of imports, then a country is a net exporter of renewable resources and ecological services.

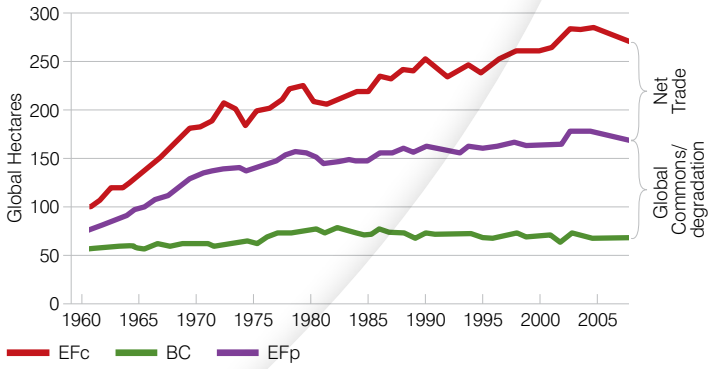
Conversely, a country whose Footprint of imports is higher than that embodied in exports depends on the renewable resources and ecological services generated by ecological assets from outside its geographical boundaries.

When compared against the biocapacity physically available within a country's borders, a resource-security metric can be obtained: the biocapacity deficit. A state of biocapacity deficit occurs when residents of a country consume more, in net terms, than the biocapacity of the country can provide. The biocapacity deficit is therefore composed of three components:

1. The net import of resources (whether as raw materials or embodied in goods and services) from outside a country's borders;
2. Over-harvesting of domestic resources;
3. Demand on the global commons such as fishing international waters or putting a demand on global carbon sinks.

Figure 4 provides an example of a country's trends in biocapacity and Ecological Footprint of both production and consumption.

FIGURE 4:
Ecological Footprint of consumption, Ecological Footprint of production, and biocapacity.



The three components that make up a potential biocapacity deficit can be used to group ecological risks into types. Each type is characterised by a particular time horizon during which it builds up and can be acted upon, which is described below. The time horizon provided should not be seen as a forecast of when risks might materialise

within a country. Rather, they relate to the nature of the risk driver and time-frame over which the risk develops and the time-frame necessary for turning trends around.

Short-term risks concern the net trade component which corresponds to the difference between the Ecological Footprint of consumption and the Ecological Footprint of production. This is the component of a country's Ecological Footprint that is most responsive to short-term phenomena such as commodity price volatility and supply disruption (e.g. due to trade restrictions). Non-renewable resources including metals, minerals and fossil fuels are factored in this analysis as well to give a comprehensive overview of short-term natural resource risks.

Medium-term risks are those that are linked to the overuse of ecological assets leading to environmental degradation over time. It is expressed as the difference between the country's Ecological Footprint of production and its biocapacity. When an economy's demand is larger than its biocapacity, countries run the risk of degrading and reducing the productive capacity of their ecological assets.

Long-term risks are linked to the carbon emission component of the country's Ecological Footprint and are more uncertain in nature (Note that the cost of fossil fuel is already part of the short-term risks - it is only the emissions from their use which are still largely free of charge). Certain risks are centred on the CO_2 emissions the nation emits, such as the possibility of a future carbon tax or pricing mechanism. Other risks are linked to global emissions rather than purely national ones and are likely to exacerbate the short and medium term risks outlined above.

TABLE 1:
Typology of natural resource risks by timeline, nature, and effect.

Short-term risk	Medium-term risk	Long-term risk
Up to 5 years	5-10 years	10-25 years
Abrupt changes in international commodity trade markets	Cumulative environmental degradation from natural resource overuse	Emission of carbon dioxide (slower and potentially more long term)
Exposure to price volatility of commodities and supply disruption	Reduced productivity of natural resources (soil, crops, fish stocks, etc.) leading to reduced output of products derived from it.	Exposure to carbon pricing and climate change impacts

BOX IV:
Clarifications and Limitations

Natural resources and environmental risks: The Ecological Footprint is not a fully comprehensive indicator of environmental risk. It is merely a biocapacity accounting framework. Therefore, it does not directly assess climate change risks, water and air pollution, toxicity, freshwater availability, biodiversity loss, or soil degradation. However, biocapacity levels will respond to many changes in the states of these indicators as these environmental risks manifest themselves through changes in local yields, which are integral to the calculation of biocapacity. For example, if climate change causes drought, or overharvesting causes loss of soil productivity, biocapacity will decrease, which will be reflected in the National Footprint Accounts of the country. Also, the Footprint methodology measures biological resource flows, not fossil fuels, metals and minerals. The latter have been included in the E-RISC methodology through the utilisation of additional data sources.

Resource stocks and flows: Since both the Ecological Footprint and biocapacity represent resource metabolism or flows, there is no direct estimation of resource stocks within the Ecological Footprint framework. Nevertheless, the comparison of the two indicators provides a direct estimation of changes in stocks and thus indicates potential risks of stock depletion.

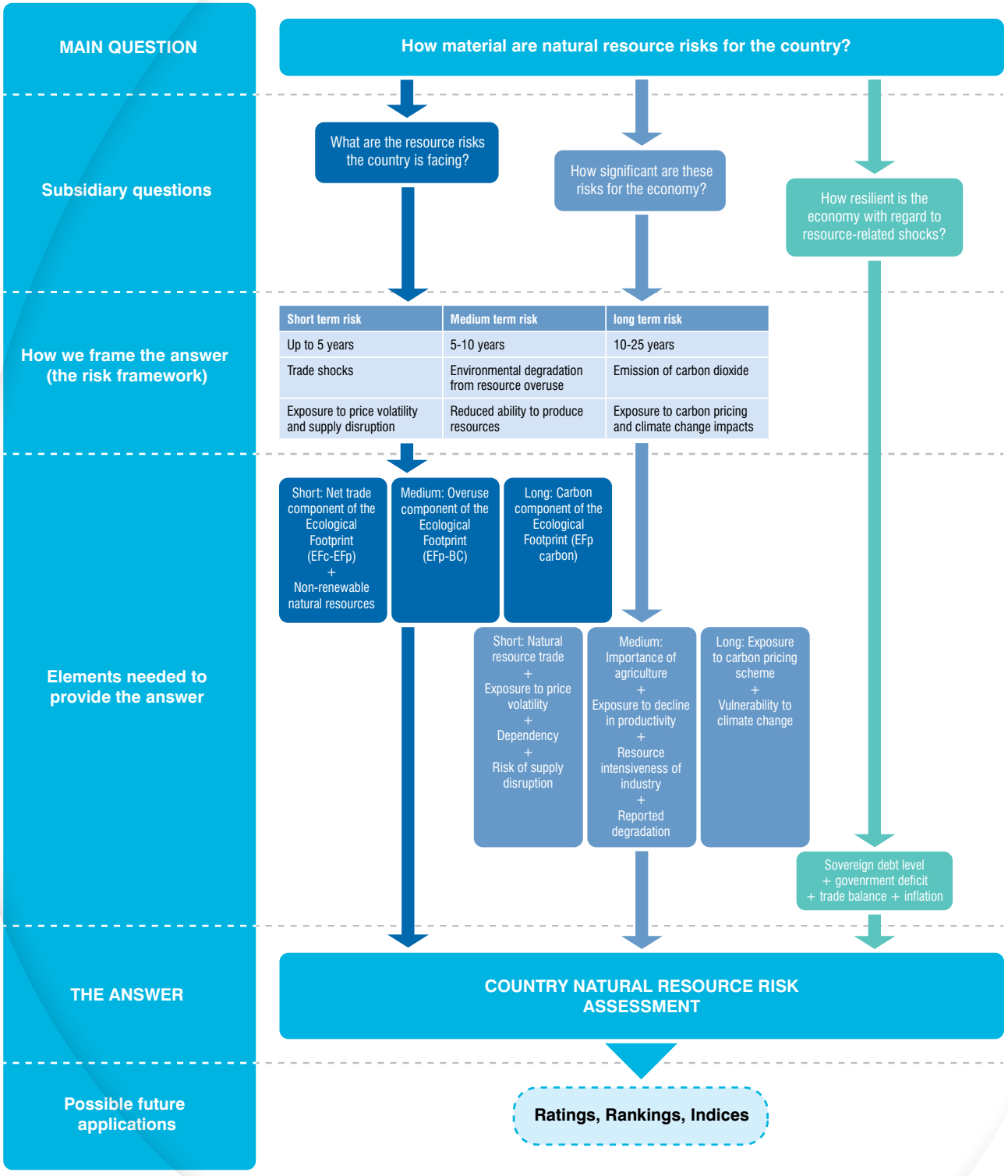
Descriptive vs. Prescriptive measure: Biocapacity indicates the ability or potential of an area of land to provide resources and services for people. Due to aggregation at the national scale, the Ecological Footprint may be poorly suited for making predictions of land use change patterns. For example, if a country is harvesting more forest products than can be renewed each year within its borders, then one can make the observation that the stock of timber biomass is decreasing. However, without knowing the geographic pattern of harvesting (e.g. clear-cutting or thinning of stands) it is difficult to make recommendations as to optimal land use patterns.

6. E-RISC: Approach and Results

Figure 5 schematically describes the E-RISC methodology, which includes (1) the resource situation for a county; (2) the economic significance of resource risks; and (3) the financial resilience to adverse shocks.

The E-RISC methodology has been applied to five countries exhibiting a wide range of resource profiles, risks and resilience to adverse natural resource-related impacts. The countries have been chosen based on consultations with the participating financial institutions. A more thorough analysis applied to a larger number of countries in future assessments will provide a more comprehensive overview.

FIGURE 5:
The E-RISC Methodology and its components can be visualised as follows:

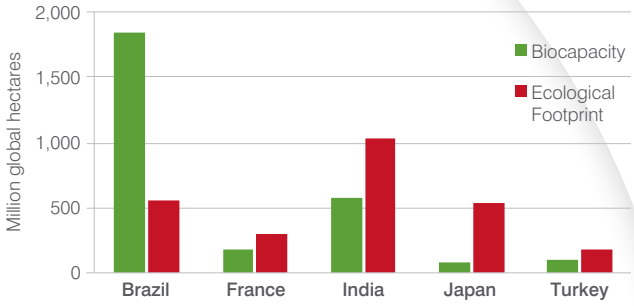


STEP 1:
Examines the resource situation of countries.

The five countries chosen as case studies exhibit a wide range of resource profiles (Figure 6). Brazil, for example, possesses the largest amount of biocapacity of any country in the world and is a biocapacity creditor despite its growing consumption and exports. Japan, in contrast, demands seven times more biocapacity than it has within its borders.

There are significant contrasts in how the Ecological Footprint and biocapacity situations have evolved among the countries (Figure 7). While Japan's Ecological Footprint has remained stable over the past two decades, Turkey's has grown resulting in the country becoming a ecological debtor in the early 1970s.

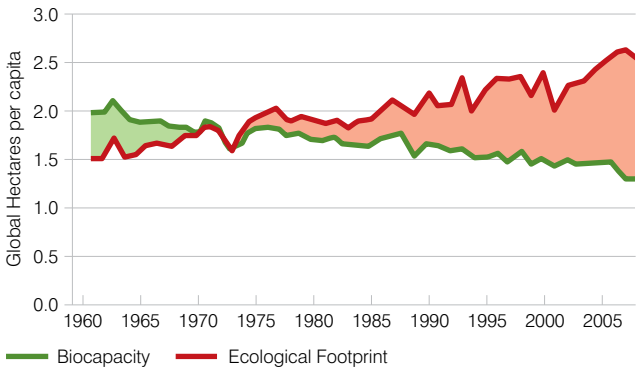
FIGURE 6:
The Ecological Footprint and biocapacity of the case study countries, 2008.



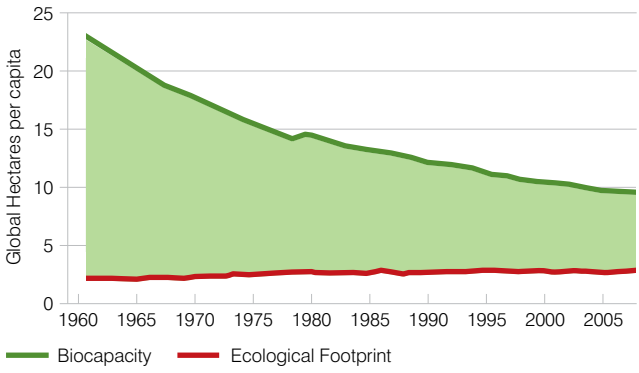
Data Source: Global Footprint Network

FIGURE 7:
Ecological Footprint and biocapacity for five countries, 1961-2008. Green areas mean biocapacity exceeds Footprint and the country is therefore an ecological creditor. Red areas mean Footprint exceeds biocapacity and the country is therefore an ecological debtor. These trends are based on the National Footprint Accounts of Global Footprint Network, 2011 Edition.[30]

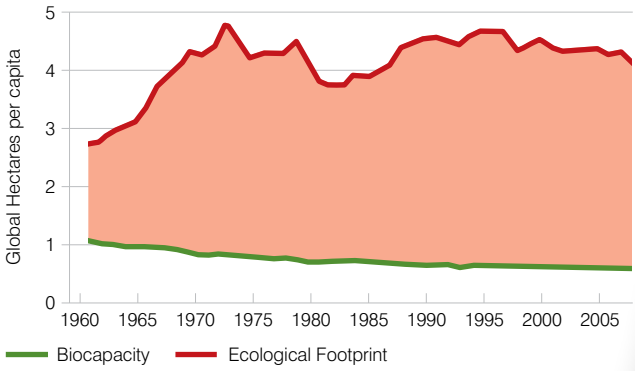
Turkey trends



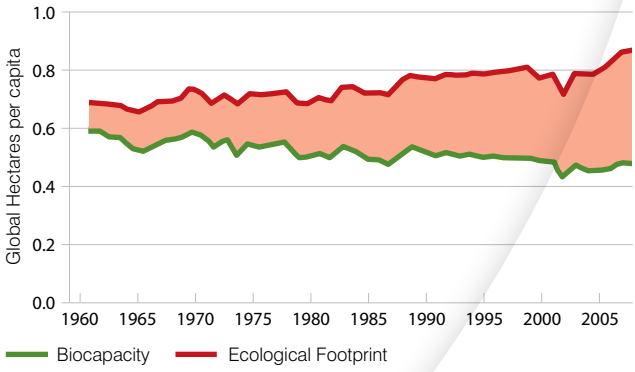
Brazil trends



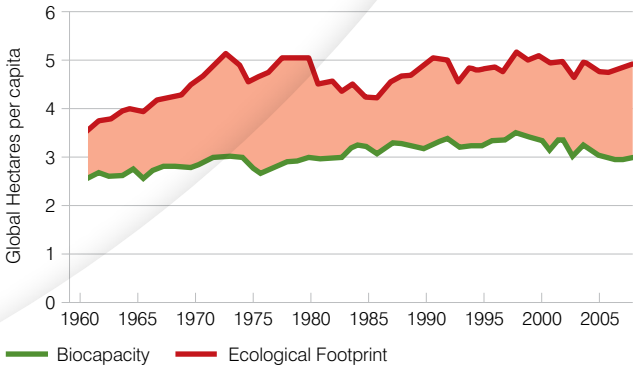
Japan trends



India trends



France trends



The role of trade varies from one country to another. Brazil is a net exporter of commodities derived from natural resources (as measured by its biocapacity) while France's imports drive the increase in its Ecological Footprint. India, on the other hand, has negligible trade in biocapacity meaning that the growth in its Footprint is being driven by growing demand on its own ecosystems to provide natural resources and services.

STEP 2: Assesses the economic significance of resource risks

Short-term, trade related risks: Many countries are exposed to risks caused by commodity price volatility that has accompanied growing global resource scarcity. This exposure is higher for countries with large percentages of natural resources in its trade and for those with large trade imbalances. France, for example, is less exposed to the risk due to its fairly balanced natural resource trade, while Brazil is exposed as a net exporter, and countries like Japan and India are exposed as net importers.

Increasing global natural resource scarcity also puts security of supply at risk for some countries. Exposure to such risks depends largely on how dependent a country is on imported resources for its own consumption and economic activities. Countries such as Brazil or India that still meet over 90 per cent of the demand for renewable natural resources from domestic sources are less at risk than a country such as Japan that is dependent on imported resources for nearly two thirds of its consumption. The risk of supply disruption is also linked to a country's trade pattern. Indeed, Turkey notably faces a larger risk due to the fact that four out of the five countries from which it imports the most biocapacity are themselves in biocapacity deficit.

Figure 8 shows the simulated effects of a 10 per cent change in the price of natural resource-related commodities (renewable and non-renewable) in terms of its effect on a country's trade balance (in per cent of GDP). Given the recent fluctuations in prices for a number of commodities (soft commodities as well as ores and minerals), this is a relatively conservative scenario. A GMO study,[31] for example, found that even though prices for the 33 most important commodifies in the 20th century had declined by 70 percent, these declines had been completely offset or reverse between 2002 and 2012.

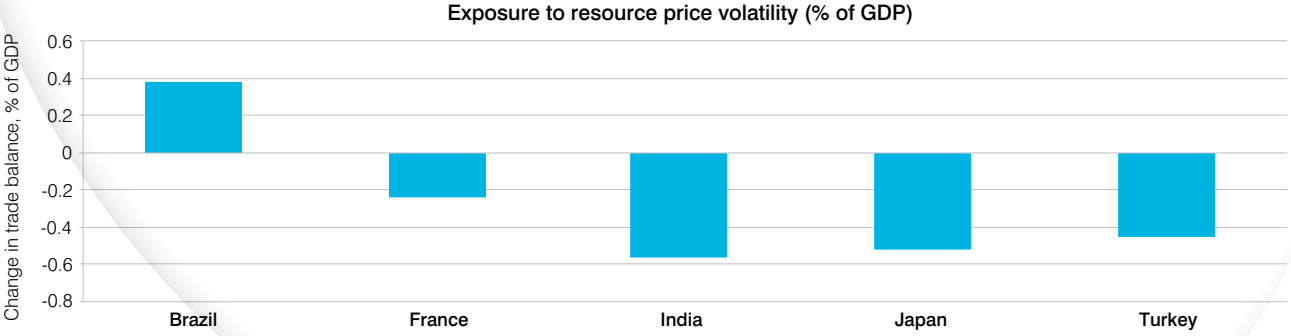
The results show that effects are weaker for a country like France with more balanced resource trade than for countries with natural resource trade deficits (e.g. India or Japan, or in the case of net exports, Brazil).

Medium-term, environmental degradation-related risks: Some countries also face threats to their economic performance if resource overuse leads to a loss in biocapacity. Overharvesting of resources does lead over time to the degradation of the productive capacity of ecological assets. Economically, this risk will have greater impact for countries that depend on agricultural activities for a large share of total output and employment.

Figure 9 below shows the simulated effects of a 10 per cent reduction in the productive capacity of ecological assets in terms of trade balance should consumption levels remain the same. Turkey stands out in this respect as it currently produces higher value added products than it imports. If this production were to fall due to degradation of renewable natural resources, these higher value added products would have to be imported, with repercussions for the country's trade balance.

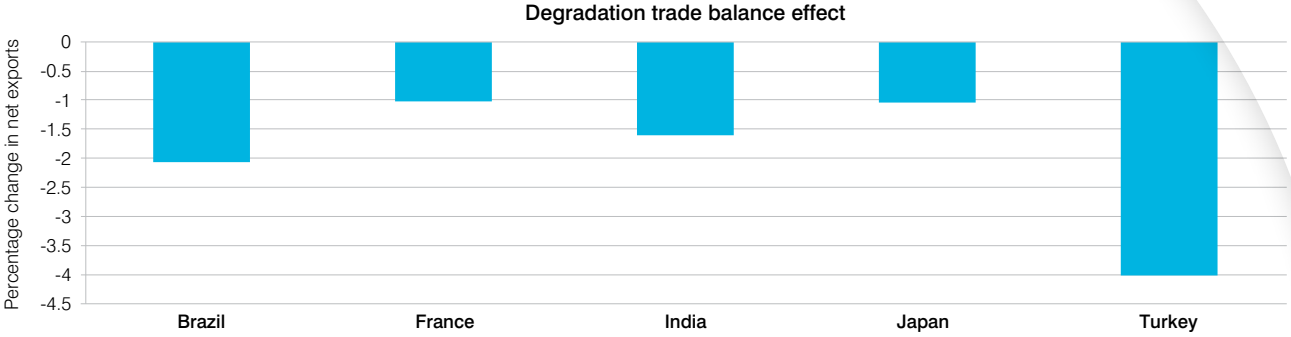
Long-term carbon emissions-linked risks: Looking at longer-term risk drivers, the methodology examines countries' emissions of carbon dioxide (Figure 10). The risk that is most directly tied to a country's own emissions is the introduction of a carbon pricing scheme or tax. This risk is of course highly contingent upon the modalities of a potential price or tax, including how much of the tax stays within the country. Under a cap and trade system, however, the higher CO_2 emissions a country has, the higher the potential costs.

FIGURE 8:
Change in trade balance as a result of a 10 per cent increase in the price of natural resources.



Source: Global Footprint Network calculations based on UNCTAD data for 2010.

FIGURE 9:
Changes to countries' trade balance as a result of a 10 per cent reduction in productive capacity of their ecological assets and assuming that consumption levels are maintained. Results show the diversity of countries' financial exposure to potential losses in biocapacity.



Source: Global Footprint Network calculations.

Though risks are largely linked to a country's total emissions, the differences in per capita levels are remarkable. India, for example, is one of the largest emitters in the world while its per capita emission levels are the lowest of the five countries studied. For many countries, there are also significant risks associated to their exposure to climate change and its effects. Although these risks are linked to global levels of emissions and the country's geographic specifics, rather than the country's own emissions, they would also need to be considered in a full analysis in order to recognise the potential for climate change to exacerbate the other natural resource risks outlined above.

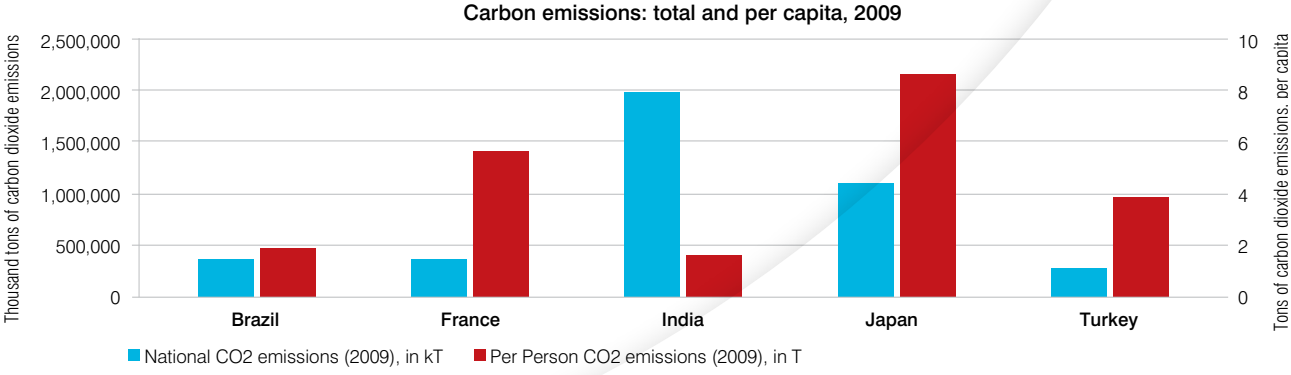
STEP 3:
Evaluating resilience to adverse shocks

Countries do not only differ in the nature and magnitude of the natural resource-related risks that they face. They also vary in their ability to absorb the macroeconomic shocks associated with such risks. High levels of sovereign debt, budget deficit, trade deficit or inflation would all constrain a country's ability to deal with adverse shocks and increase the risk that such shocks would negatively affect the country's credit worthiness. Table 2 shows the macroeconomic situation for each of the five countries measured according to four indicators.

TABLE 2:
Main financial resilience indicators – 2011 (IMF's World Economic Outlook 2012, and World Bank)

	Brazil	France	India	Japan	Turkey
Gross debt (as % of GDP)	64.9	86.0	67.0	229.6	39.3
Government surplus/deficit (as % of GDP)	-2.6	-5.2	-9.0	-9.8	-0.2
Trade Balance (as % of GDP)	0.8	-3.4	-6.0	1.4	-9.8
Inflation (2006-2010 yearly average, %)	4.7	1.5	8.8	-0.1	8.9

FIGURE 10:
Total and per capita emissions of carbon dioxide for Brazil, France, India, Japan, and Turkey (in kilotonnes (blue bar) and tonnes per capita (red bar)).



BOX V:
Key Findings

Resource situation. The five case study countries showcase the wide variety of natural resource production, consumption and trade patterns that countries exhibit and the nature and level of resulting risk. Biocapacity varies considerably among countries (Figure 6 and 7). In absolutes, Brazil has more than 14 times the biocapacity of Japan. Per capita differences for 2008 are even further apart, with Brazil having 20 times more biocapacity per person than India, the country with the least amount of biocapacity among those five studied.

Economic significance of resource risks. Results across the five countries studied show how risks relating to trade effects from a price volatility scenario and ecological degradation can differ widely. For instance:

- A 10 per cent variation in commodity prices can lead to changes in a country's trade balance equivalent to between 0.2 and 0.5 per cent of GDP, which means that resource dependency and exposure to price volatility as shown in Figure 8 vary by factors of more than two.
- A 10 per cent reduction in the productive capacity of renewable, biological resources, assuming that consumption levels remain the same, could lead to a reduction in trade balance equivalent between 1 and over 4 per cent of a nation's GDP. This means that exposure to degradation effects varies by more than four times for the five case study countries shown in Figure 9.

Results show that there are highly differentiated natural resource-related risks among the countries. Growing global resource scarcity, therefore, exposes importers and exporters, as well as ecological creditors and debtors, to increasing risks linked to commodity price volatility and environmental degradation. In addition, contrary to conventional beliefs, these risks may not only emerge in the medium to long term, but also in the short term (0 – 5 years).

Financial resilience to resource risks. The macroeconomic situation also differs greatly among the five case study countries (Table 2). Investors, rating agencies and banks are encouraged to assess how natural resource risks can be compared against these macroeconomic indicators and can be factored in sovereign risk analysis.

The results show that the E-RISC methodology brings added value to traditional sovereign credit risk analysis by shedding light on risks that are both material and inadequately covered in current analysis.

7. A Roadmap to Integration

A Roadmap to Integration

Analysis, such as the type presented here, can assist fixed income investors and country analysts in embedding unaccounted for factors into risk assessments. But ultimately, an investor will need to be able to use the information provided by these risks assessments to compare countries to one another within a given investment universe. The direct financial consequences of environmental risk would need to be measurable and quantifiable, on a forward looking basis as well, in order for these factors to be included in investment models or in a rating process. While the framework provided by the E-RISC model is a first step, further work is required for providing a robust tool for investment analysis.

The comparative assessment is intended to be used as a starting point for comparing risk profiles and for further exploration and development. This framework could be further developed by investors, banks and CRAs to rate or rank countries, based on their own needs and criteria. In order to provide simple metrics that can easily be compared across countries, the country risk profiles developed as a part of this project have been distilled into four dimensions: 1) resource balance; 2) trade risk; 3) degradation risk; and 4) financial resilience to shocks (Figure 11). The grading is based on a total set of 20 indicators whereby each indicator receives a score of between -2 (more exposure to risk) and +2 (less exposure to risk) for each country (see Appendix I).

- **Resource balance** grades the ratio of the country's Ecological Footprint to its biocapacity.
- **Trade related risk** evaluates the country's exposure to natural resource price volatility as well as its exposure to supply disruption.
- **Degradation related risk** assesses the country's exposure to declining productivity of its ecological assets as a result of resource overharvesting.
- **Financial resilience** appraises the ability of a country to respond to adverse macroeconomic shocks.

The comparison illustrates the highly differentiated nature of resource risks across countries both in terms of overall risk exposure and in terms of its component elements. Since resource risks do not follow the same gradient as country ratings, the E-RISC approach can potentially add a new dimension to current assessments of sovereign credit risk.

FIGURE 11:
Overview Results of the Comparative Assessment Tool

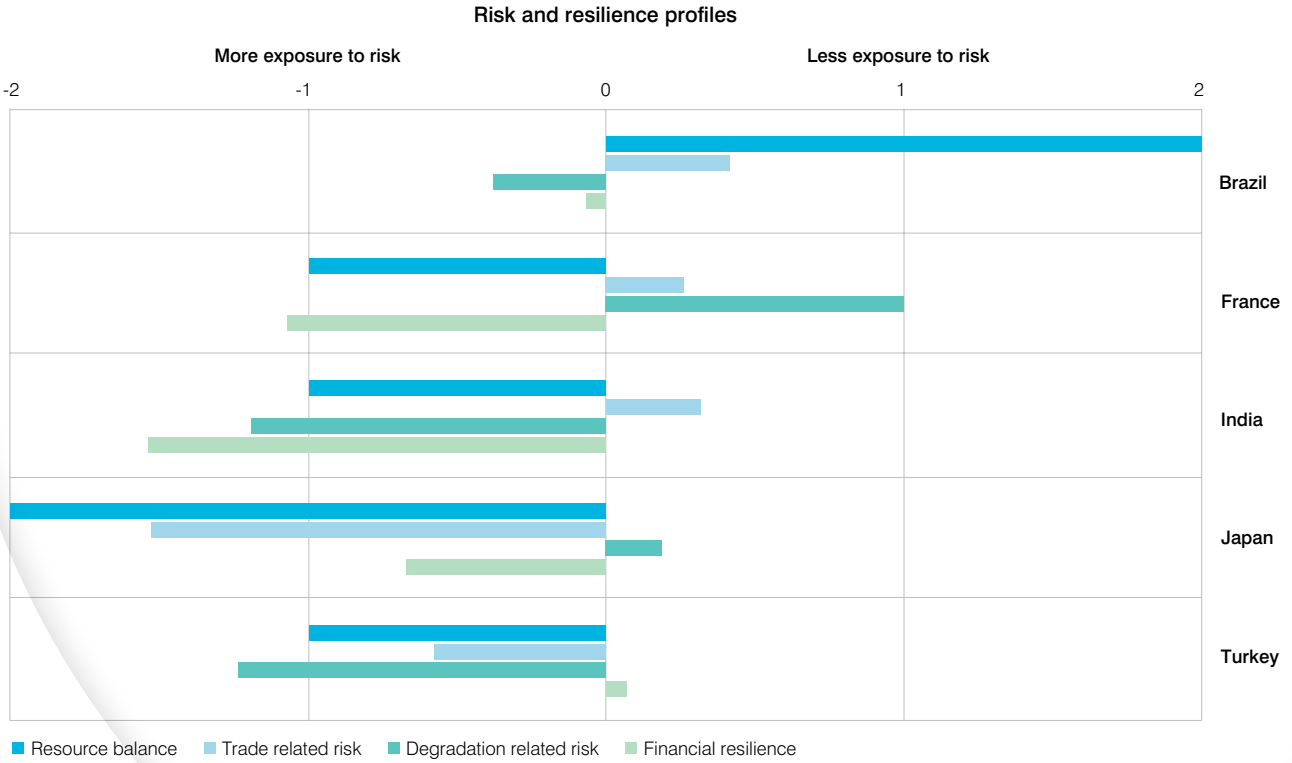
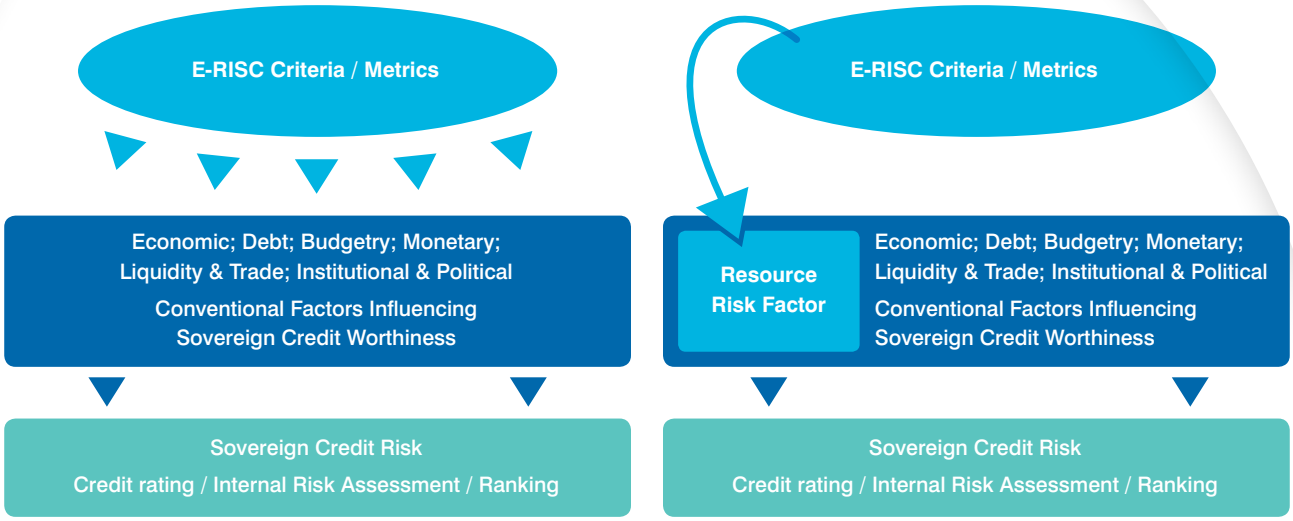


FIGURE 12 (left) and FIGURE 13 (right):
Potential models of E-RISC integration into credit rating methodologies.



The steps taken to develop the comparative assessment are vital for eventually linking and integrating resource risks into traditional sovereign credit risk assessments, as opposed to generating a set of stand-alone ESG ratings.

One option is that individual E-RISC metrics could be integrated into current traditional risk factors (Figure 12). For example, the supply disruption or trade exposure to degradation indicators could be integrated into specific economic risk factors. This choice could allow direct linkages to be made between natural resource risks and currently applied sovereign credit risk factors.

Alternatively, a separate natural resource risk factor could be generated in addition to the current list of sovereign credit risk factors (Figure 13). This factor could serve as a catch all to capture the relevance of natural resource risks to specific macro-economic indicators, as the analysis in this report has done.

Furthermore Table 3 highlights a number of methodological enhancements, including improvements in the analysis of supply and demand for natural resources and their flows through the economy, which could be developed in future efforts to improve the robustness and applicability of the E-RISC approach.

TABLE 3:
Extending and Enhancing the Analysis: Areas for Future Development

	Area of analysis	Suggested improvements
Country's resource situation	Ecological Footprint and biocapacity Non-renewable natural resources	Using Input-Output analysis to analyse resource use in the economy Better integration of ores and minerals in the analysis
Country's exposure to natural resource risks	Exposure to price volatility Risk of supply disruption Exposure to productivity loss Cost shifts in country's biocapacity deficits Resource intensiveness of industry Reported degradation Risks linked to the country's carbon emissions Exposure to climate change risk	Applying better modelling to predict effects of volatility Using multi-regional input output analysis to better understand trade-related vulnerability Applying better modelling to predict effects of falling productivity of ecological assets What does it cost a country to access the resources it cannot renew within its own boundaries, and how are these costs changing over time? Using Input-Output analysis to analyse resource intensiveness in different industries Systematise analysis of environmental degradation, separate carbon from Footprint of production, incorporate additional measures of degradation Increase sophistication of analysis regarding carbon pricing, trading, or taxing. Systematise and refine analysis of climate change vulnerability
Country's financial resilience	Sovereign debt level General	Consider a wider array of debt indicators to better identify risk. Widen the set of indicators used to assess financial resilience to adverse macroeconomic shocks.

8. How the E-RISC Methodology can be Applied in Capital Markets

The natural resource-related risks presented in E-RISC are relevant for a variety of financial analysts working on country level risk in such areas as bond risk, country credit rating, project finance, trade finance, insurance and re-insurance. For instance, country risk analysts in fixed income departments could choose to apply their own weighting to the criteria in the comparative assessment which would result in a ranking or rating tailored to their own needs.

Credit rating agencies: The E-RISC methodology has presented natural resource risks over the short- and medium-term horizons so that materiality could be demonstrated for relevant time frames applied in sovereign credit ratings (3-5 years). In light of the growing calls for greater oversight and regulation of rating agencies,[32] this is an opportune moment for CRAs to show leadership by taking a more proactive and comprehensive approach to assessing and embedding emerging risks into conventional sovereign credit risk assessment. CRAs could also choose to take these risks into account as part of the longer-term risks that are likely to impact future fiscal balance and debt burden if not adequately managed over the short to medium term.[33]

Just as CRAs have shown a pro-active approach to highlighting longer-term demographic risks to fiscal balance, they could work more closely with investors to gauge demand for the incorporation of environmental risk factors into credit ratings. There are also a number of other players in the credit rating agency market as well as a growing number of newly formed or developing institutions.[34] Fully accounting for environmental risks could be an important way for these less-established players to differentiate themselves.

Institutional investors in particular are exposed to growing and widespread costs from environmental damage through their long-term portfolios. In 2008, global environmental externalities from human activities were estimated by Trucost to be at US $ 6.6 trillion in a study commissioned by the UN-backed Principles for Responsible Investment (UN PPRI) and UNEP FI.[35] Institutional investors therefore have a financial interest in pushing the frontiers in the integration of systemic risks from natural resource use and environmental degradation in order to promote long-term and stable wealth creation.[36] Furthermore, asset owners have a responsibility to ensure that asset managers are taking material resource risks sufficiently into account in their investment decision making and risk analysis (see Box VI).

BOX VI:
Limitations of the Universal Ownership Principle for Sovereign Bonds

The Universal Ownership Report clearly communicated the role that long term investors and asset owners have in engaging with and influencing companies to reduce environmental externalities and thus reduce overall exposure to costs from environmental damage and pollution. However, the concept of active ownership in relation to sovereign bonds is more complex than in relation to corporate equities. This is a challenging area of growing interest, where platforms such as UNEP FI, the UN-backed PRI and groups such as the Long Term Investor Club, could play an important role in developing guidelines on sovereign bond investing. Studies such as E-RISC can provide a starting point.

ESG Information Providers: A number of ESG information providers and investors have already utilised the Ecological Footprint as one indicator within ESG ratings.[37] While stand-alone ratings have their value and place, collaboration in future phases of E-RISC could begin to remedy the relative absence of more integrated analysis. This could help develop the body of evidence from correlations between sustainability factors and credit worthiness to financially material linkages. Furthermore, engagement with E-RISC could build on improvements in social and governance indicators,[38] by matching them with robust environmental indicators.

Environmental Data Providers: Consistency and coverage across an investment universe is a prerequisite for integration of natural resource and environmental risks into financial decision making. Therefore, environmental database providers (UNEP GRID, GEO, and FAO, etc.) could proactively tailor global environmental data coverage so that it can be applied for financial risk analysis.

A number of participating financial institutions describe their approach to environmental risk in the context of sovereign credit risk below, as well as how the findings of the E-RISC report can be used:

Caisse des Dépôts: Mainstream macroeconomic and financial analysis for sovereign issuers suffers from two shortcomings: 1) a restricted scope and 2) a time horizon which can be at times inferior to that of the security. The focus is on easily quantifiable parameters, overlooking linkages with non-economic criteria that can have a direct impact-and in some cases within a short time frame-on those exact variables on which a rating depends. Only a few parameters, such as demographics, are available for long-term forecasting. Integrating the biocapacity dimension provided by this report to long term fixed-income investors' methodology lessens the risks of under evaluating threats to a country's ability to repay its debt over the long run, hence making its risk allocation more rational.

Bank Sarasin's methodology for rating sovereign bonds from a sustainability perspective makes heavy use of both biocapacity measures and the Ecological Footprint. These indicators tell us a lot about the very foundation of economic activities, notably the availability and the utilisation of resources around the world. Moreover, by distinguishing between the Footprint of production and consumption, we can gauge the international flows of embedded resources. This in turn is an important proxy for the sustainable competitiveness and also the vulnerability of nations. During the recent turmoil on bond markets, this analysis proved to be a valuable tool for selecting sovereign bonds. The E-RISC report further deepens our understanding of the relationship between resources and sustainable economic activities and strengthens our belief in the utmost importance of responsible resource management both on a national and on a global scale.

KfW already incorporate environmental aspects for investments in sovereign bonds. So far the credit analysis and the sustainability analysis (this includes environmental criteria as well as governance and social criteria) of an issuer is done separately. Against the background of an increasing shortage of natural resources and global climate change we are convinced that environmental aspects will become a vital issue for a country's economic performance. Up to now our country rating method does not account for environmental aspects. Therefore we regard E-RISC as a forward-looking project, which will improve the understanding of the short- and long-term relationships between ecological risks and economic performance. It will help us to refine our country rating methodology and to make better investment decisions.

National Australia Bank believes that natural resource and environmental risks should always be considered as part of a balanced approach to assessing any counterparty risk. This should include non-financial (ESG) components as well as pure economic drivers, as ultimately these non-financial elements will affect a counterparty's economic health, be they a business or a country. The E-RISC Report provides some valuable early thinking to help analysts quantify the impact of natural resource and environmental factors on a country's financial outlook. It is also a useful tool for providing a broader view of businesses operating in different countries, and gives an ESG context to risk assessment.

9. Conclusions

It has been a turbulent four years since the financial crash of 2008, for rating agencies, sovereign debtors and bond holders. The on-going sovereign debt crisis that followed on from the crash continues to dominate economic and financial headlines in the United States and Europe, with global reverberations. E-RISC has developed a method to better understand the material relevance of an overlooked aspect of sovereign credit risk: natural resource and environmental risk. E-RISC uses the Ecological Footprint to explore and explain resource and environmental challenges. In doing so, the report presents a clear picture of how the Footprint can shed light on these highly complex and pertinent issues. Phase I has shown the relevance of natural resource and environmental risks for financial materiality, by demonstrating potentially significant economic costs through exposure to trade disruption and environmental degradation. It has further shown that these risks show no correlation to current sovereign bond risk ratings. Also, contrary to the commonly held belief, these risks may not only emerge in the medium to long term, but even in the short term.

There are a number of environmental risks that E-RISC did not cover. Metrics relating to other areas of environmental vulnerability such as the loss of ecosystem services, water scarcity and climate change impacts could further enhance the scope and breadth of the assessment. However, amidst the burgeoning growth of ESG tools and ratings available to investors, the project partners focused on a more narrow set of quantitatively-based natural resource and environmental metrics that could most easily be linked with those used in conventional credit risk analysis. By starting with the factors most easily linked to financial materiality, the E-RISC approach sought to significantly accelerate the uptake and acceptance of environmental risk parameters into country credit ratings.[39]

Commodity markets, food prices and food and resource security are becoming increasingly volatile, exacerbated by climate change-caused weather extremes and uncertainty.[40] Raters, investors and governments alike will therefore need to not only become more aware of the repercussions of these trends on a country's economy, but also better able to assess the impact of these risks within sovereign credit risk assessment. Sovereign wealth funds, pension funds and other asset owners have the potential to be key leverage points[41] for driving transformation to more comprehensive risk frameworks, by collectively requesting rating agencies, or mandating asset managers, to account for the risks demonstrated in this report. This in turn could catalyse industry level change in terms of acceptable risk accounting standards at both country and company levels.[42] Risk analysts can show significant leadership by improving their frameworks to better fit emerging challenges and risks.

Moreover, the country level risks described in this report are relevant to any financial actor interested in medium- to long-term country risk forecasts in order to contextualise their own investment and lending portfolios across different nations. This includes trade finance, project finance, insurance, reinsurance and development finance undertaken by such institutions as the International Monetary Fund and the World Bank.

Finally, governments themselves have a critical role to play in driving transformation to more sustainable pathways in an increasingly complex, inter-connected and natural resource-constrained world. The country trends presented in this report are in no way unique to the case countries chosen. They are representative of the changing global context, as resource pressures increase along with growing human demands for natural resources and services that can no longer be met by the planet's limited biocapacity.[43]

The risk framework described in this report is indeed just one piece of the complex puzzle needed to understand sovereign credit risk. But it is a piece that is currently unaccounted for in ratings and risk assessments. The E-RISC framework is therefore an important lens for understanding sovereign credit risk, and enhancing current analytics, in an increasingly resource constrained 21st century.

Appendix I

Table 4 presents twenty indicators used for measuring the four dimensions that make up the comparative assessment tool presented in section 7. The four dimensions are: (1) resource balance; (2) trade risk; (3) degradation risk; and (4) financial resilience.

TABLE 4:
Indicators, criteria and weightings for the Comparative Assessment Tool

Indicator	Description	Source
Resource balance		
Footprint/ Biocapacity ratio	Ratio of Ecological Footprint over biocapacity	Global Footprint Network, National Footprint Accounts
Trade-related risk (short-term risk factors)		
Exposure to price volatility	Change in trade balance from a 10 per cent change in resource prices, expressed as a percentage of GDP	Calculated from UNCTAD trade data.
Footprint trade ratio	Ratio of the country's Ecological Footprint of consumption over its Ecological Footprint of production	Global Footprint Network, National Footprint Accounts
Fuels trade ratio	Ratio of the country's fossil fuel consumption over its fossil fuel production	U.S. Energy Information Administration
Footprint trade ratio trend	Average yearly growth rate over the last ten years of the net trade component of the country's Footprint (EFc-EFp)	Global Footprint Network, National Footprint Accounts
Fuels trade ratio trend	Average yearly growth rate over the last ten years of the net trade component of the country's fuel consumption (fuel consumption – fuel production)	U.S. Energy Information Administration
Dependency	Ratio of the country's total resource demands, in biocapacity terms, which is met through domestic production.	Calculated from Global Footprint Network, National Footprint Accounts
Risk of supply disruption	Number of countries, out of the country's top five resource suppliers in biocapacity terms, who are themselves have a biocapacity deficit.	Calculated from Global Footprint Network, National Footprint Accounts
Natural resource trade balance	Exports minus imports of natural resources, in share of GDP	UNCTAD data
Degradation-related risks (medium term risk factors)		
Resource overuse ratio	Ratio of the country's Ecological Footprint of production over its biocapacity.	Global Footprint Network, National Footprint Accounts
Agricultural output	Share of Agriculture in the country's total value added, as percentage of GDP	World Bank, World Development Indicators
Agricultural employment	Percentage of the country's total employment accounted for by agriculture	CIA World Factbook
Agricultural Exports	Percentage of the country's total merchandise exports accounted for by food and agricultural raw materials	UNCTAD data
Agricultural Imports	Percentage of the country's total merchandise imports accounted for by food and agricultural raw materials	UNCTAD data
Exposure to degradation	Change in the country's trade balance as a result of a 10 per cent fall in production of renewable natural resources. Expressed as a share of GDP.	Calculated from Global Footprint Network, National Footprint Accounts
Exposure to degradation trend	Average yearly growth rate over the last ten years of the resource overuse component of the country (Ecological Footprint of production minus biocapacity)	Calculated from Global Footprint Network, National Footprint Accounts
Financial resilience		
Debt	Country's general government gross debt, as share of GDP	IMF World Economic Outlook Database
Government budget balance	Country's general government net lending/borrowing, as a share of GDP	IMF World Economic Outlook Database
Trade balance	Country's total merchandise exports minus total merchandise imports.	UNCTAD data
Inflation	Yearly average consumer inflation over the last five years	World Bank, World Development Indicators

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UNEP Finance Initiative (UNEP FI) and Global Footprint Network started discussing this project in 2010 as a means for advancing metrics to enable financial institutions to integrate natural resource and environmental risk indicators in sovereign bond analysis and sovereign credit risk models. Together with a number of financial institutions, the E-RISC project was started in January 2012. The findings of this work also aim to contribute to the development of metrics as part of the Natural Capital Declaration.

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