MSCI Climate Value-at-Risk (VaR) Methodology

MSCI ESG Research

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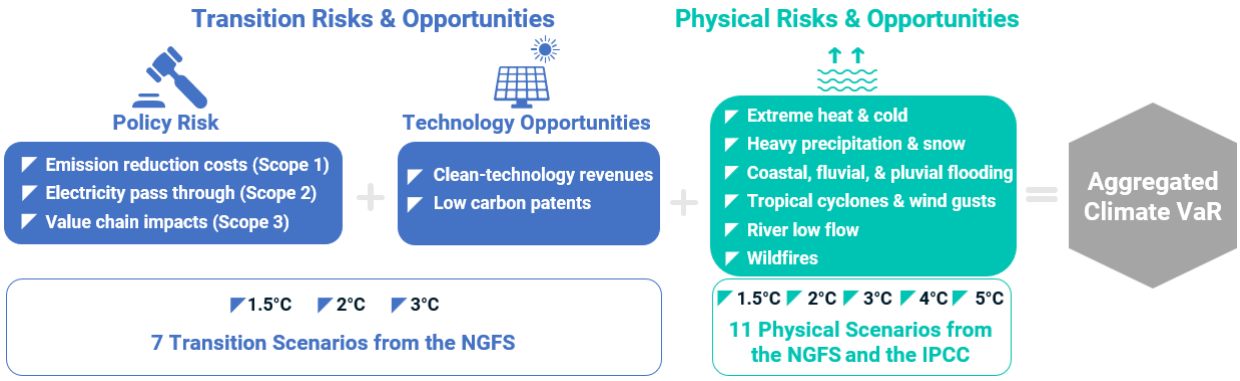
Contents

1. Introduction

Climate Value-at-Risk (Climate VaR) provides a forward-looking and return-based valuation assessment to measure climate-related risks and opportunities. Climate VaR is a quantitative assessment calculated at the company and security level. The aggregated company Climate VaR is calculated as a percentage of market value (from -100% to +100%) for multiple climate scenarios and includes the valuation impacts arising from technology opportunities, policy risks and physical risks.

The Climate VaR model uses a data-driven approach, examining a company's positioning within its industry and the regions where it operates. It considers the potential costs and profits associated with different climate scenarios, including the impacts of carbon pricing, regulatory changes, and physical climate events. By simulating these scenarios, the model estimates how climate change could affect a company's financial performance and overall valuation.

Exhibit 1: Pillars of the Climate VaR model



Source: MSCI ESG Research, as of June 2024

Exhibit 1 provides the Climate VaR framework. Climate VaR is composed of the following pillars:

- Policy risk
- Technology opportunities
- Physical risk and opportunities

These pillars are further broken down into the categories listed in Exhibit 1. Cost estimates are made for each pillar under multiple climate scenarios from the Network for Greening the Financial System (NGFS) and Intergovernmental Panel on Climate Change (IPCC). This enables the understanding of climate risk exposure for individual drivers and in aggregate within a consistent and holistic framework.

2. Interpretation of Climate VaR

The Climate Value-at-Risk output is a measure of both a company's potential climate cost exposure and a measure of how climate change may affect a company valuation. This is outlined in the broad calculation steps of the Climate VaR output.

The Climate VaR model estimates annual net climate costs[1] for a company for each scenario and pillar. Climate costs/profits for each pillar are determined separately, allowing for an understanding of the component climate risks and opportunities driving the aggregated result. The high-level steps of the Climate VaR modelling process are as follows:

Step 1: Estimate a time series of forecasted undiscounted net climate costs for a company.

These time series are the most fundamental output of the Climate VaR framework, enabling the assessment of net climate cost exposure of individual companies over time.

Step 2: Calculate the sum of the present value of future net climate costs.

The time series of future net climate costs are discounted back to their present value and then summed. This total represents an estimate of the net climate cost exposure of the company, taking into account the time value of money when assessing costs incurred at different horizons.

Step 3: Revalue the company accounting for the summed present value of future net climate costs.

The company's current valuation (enterprise value including cash or EVIC) reflects current expectations of the discounted sum of its future free cash flows. To understand how new net climate costs may affect this valuation, the present value of these new costs is subtracted from its current valuation. Company Climate VaR output for each scenario and pillar is the percentage devaluation (or appreciation) of the company after these net costs (or net profits) have been accounted for.

The Climate VaR model also provides an output for company equity, company debt, and at the individual bond security level. The split of climate costs between equity and debt holders is based on the assumption that debt holders are only affected by a cost shock to the extent that it increases company default risk. This results in Equity Climate VaR always being equal to or greater in magnitude than Debt Climate VaR. For a company with a high credit worthiness, a relatively large climate cost exposure (and thus a relatively large company Climate VaR) is often accompanied by low debt Climate VaR. The Climate VaR model employs a Merton-type credit model to calculate effects on default risk and thus allocate costs to company equity, company debt, and specific company bond securities.

Key assumptions

Climate VaR output relies on the following key assumptions:

- Current company valuations do not reflect any future climate costs.
- The adjusted valuation reflects the "pricing in" of all future climate costs from a given scenario.

These assumptions are extreme in that they result in the maximum devaluation possible for the company given estimated climate costs.[2]

Due to these assumptions, Climate VaR values are *not a return forecast for a specific horizon*. It is possible and even likely that current valuations reflect some future climate costs, or that scenario-specific future climate costs will not be fully priced in a specific time period.

[1] The output of the transition opportunities pillar are profits, not costs. If these opportunities exceed all other climate costs, sum of all pillars will be net profits (negative net costs). We refer to all time series here as net costs for ease of exposition.

[2] If the present value of climate profits exceeds climate costs, Climate VaR output instead reflects the maximum appreciation of the firm due to climate costs.

Climate VaR is equal to the present value of climate costs as a percentage of the company's current valuation, and thus provides a single number reflecting the climate cost exposure of different companies relative to their scale. Under many reasonable relaxations of the pricing assumptions above, Climate VaR output will still reflect relative valuation shocks across companies.[3]

3. Climate Value-at-Risk cost and profit estimation

The three major pillars of the Climate VaR model, and their underlying categories, are shown in Exhibit 1.

Transition risks and opportunities

- Policy risks: This encompasses costs due to regulatory and governmental factors.
- Technology opportunities: This focuses on business opportunities emerging from innovative clean technology products.

For the policy pillar, costs from direct Scope 1 emissions reduction are calculated by translating NGFS-provided regional and sectoral carbon reduction requirements into firm-level reduction paths; these firm reduction requirements are then multiplied by the scenario's carbon price[4] forecast to estimate total reduction costs incurred by a company. The costs of higher electricity prices and shocks to a company's value chain are also forecasted, with the key drivers of these costs being carbon price forecasts and the firm's Scope 2 and 3 emissions intensities. Indirect costs from Scope 3 emissions, which measure additional transition effects occurring along a company's value chain, are also accounted for. This includes upstream Scope 3 costs, which refer to the rise in input costs due to climate regulation (excluding electricity cost effects mentioned above), and downstream Scope 3 costs, which pertain to changes in product demand resulting from shifting consumer behavior and competitive transitions in downstream markets.

Potentially counterbalancing these new costs are technology opportunities: the technology pillar forecasts firm profits from new revenue streams arising from the development of new technologies serving the transition to a low-carbon economy. Total green revenues by sector are sized, then allocated to firms through forecasts of each firm's future market shares. Market share forecasts are derived from each firm's current green market share and low carbon technology patent share (as a measure of how market shares may change over time).

Physical Risk and Opportunity

- Chronic hazards: These risks manifest slowly over time and may cause business interruptions. MSCI ESG Research considers the various effects of business interruption for five chronic hazards: extreme heat, extreme cold, heavy precipitation, strong snowfall, and severe wind conditions.

[3] Such assumptions include climate costs being partially priced into current valuations and partially priced in further after a shock. For contingencies where future climate costs may only be priced to a short-term horizon, Climate VaR contains a Multihorizon CVaR module which varies the horizon to which the present value of climate costs are calculated. This can also be interpreted as a company's climate cost exposure up to a specific horizon.

[4] NGFS scenarios output carbon emissions prices, which can be interpreted as "a proxy for government policy intensity and changes in technology and consumer preferences", and not necessarily just a simple carbon tax. For more details, see the publication "NGFS Scenarios for central banks and supervisors", Network for Greening the Financial System, September 2022.

- Acute hazards: These risks occur from rare natural catastrophes, such as tropical cyclones, in distinct time intervals. Depending on the hazard type, they may cause business interruption as well as asset damage. MSCI ESG Research considers effects for six acute hazards: tropical cyclones, coastal flooding, fluvial flooding, pluvial flooding, river low flow, and wildfires.

Cash flow estimation begins with MSCI ESG Research's physical hazard models, which project changes in the intensity and frequency of various hazards in specific locations as the scenarios suggest the climate will evolve. These models overlay a firm's physical asset locations and business activity to estimate company assets exposure to specific hazards. Then, damage functions are applied to translate hazard exposures into anticipated physical asset damages and business interruption costs. All physical risk modeling offers global coverage and relies on MSCI ESG Research's Asset Location Database (ALD).[5]

4. Coverage and update processes

4.1 Coverage universe

As of June 2024, the coverage universe includes targeted and tracked indexes – including MSCI ACWI Investable Markets Index (IMI). The Bloomberg Global Aggregate Index is a targeted index for corporate fixed income coverage.

The entity for which data is collected for fixed income issuers may be a different legal entity from the one issuing the bond, in which case MSCI ESG Research's data mapping process is used to map the evaluation to the entity.

4.1.1 Minimum data requirements

MSCI ESG Research minimum data availability requirements must be met for inclusion in the coverage universe. For Climate VaR modeling, essential data include the company's market capitalization, total debt, and Weighted Average Cost of Capital (WACC). Additionally, each Climate VaR subcomponent requires specific input data to ensure coverage and accurately assess a company's risk profile. For Policy Risk Climate VaR, essential data include revenue and Scope 1 and 3 emissions. When companies do not disclose emissions data, MSCI ESG Research uses proprietary methodologies to estimate carbon emissions based on a company's revenue. For Technology Opportunities Climate VaR, clean technology revenue or low-carbon patent data are needed. For Physical Risk Climate VaR, information about the company's asset characteristics is needed, including the geolocations of the assets, their sizes, and business activities. While Policy Risk and Physical Risk Climate VaR are essential for inclusion in the coverage universe, a company can still be considered covered without a Technology Opportunities Climate VaR. In such cases, the aggregated Climate VaR comprises only the sum of the Policy Risk and Physical Risk Climate VaR.

4.1.2 Entity selection & data mapping

ESG Evaluations, including company-level Climate VaR evaluations, may be attributed to related companies. Companies are selected for ESG Evaluations through MSCI ESG Research's Entity Selection process – these are known as Data Entities. To determine which entity or entities within a group of related companies should be evaluated, MSCI ESG Research conducts a review of the

[5] Not all assets and companies in the ALD are covered by the physical risk models, as the physical risk models require company level information regarding at least revenue, market cap, and WACC to calculate physical CVaR.

companies' financing structures. Then, ESG Evaluations are attributed to related companies through MSCI ESG Research's Data Mapping process.

Data Mapping is the process whereby ESG Evaluations for a company (a Data Entity) are attributed to related companies. ESG Evaluations are mapped based on observed parent-subsidiary relationships, subject to certain company and data point requirements.

- Certain companies (such as those classified as financing companies) included in the coverage universe may be covered by data mapping from the relevant Data Entity.
- Bond issuers outside the company-level Climate VaR coverage universe may also have their evaluations mapped from parent entities that are included in the company-level Climate VaR coverage universe.

Note that company-level Climate VaR evaluations are not mapped to:

- Equity issuers; or
- Companies that have already been assessed by MSCI ESG Research.

4.2 Model input data sources

Below is an overview of the data sources used as inputs into the Climate VaR model.

- **Scenario data:** Integrated Assessment Models (IAMs) from sources such as the NGFS provide future transition pathways for assessing economic and environmental impacts of climate change, including carbon emissions pathways, global temperature projections, energy efficiency factors, and policy-related outputs like carbon pricing and mandated emissions reductions.
- **Financial data:** Financial data used in Climate VaR modeling is sourced from Refinitiv and company reporting.
- **Emissions data:** MSCI ESG Research collects greenhouse gas emissions data annually from companies in coverage, using sources like annual reports, CSR reports, company websites, Carbon Disclosure Project (CDP), and government databases. When direct disclosure is unavailable, MSCI ESG Research estimates Scope 1, Scope 2 and Scope 3 emissions using proprietary methodologies.
- **Energy usage:** MSCI ESG Research collects energy consumption data from CDP for companies that report these values. When company disclosure is unavailable, MSCI ESG Research uses an electricity estimation model.
- **Patent data:** MSCI ESG Research's technology opportunities covers patents that have been granted from over 70 patent authorities worldwide. The source for this patent data is LexisNexis IPlytics.
- **Hazard data:** Hazard data is based on observations and reanalysis data as well as on projections from general circulation models and global hydrological models from academic and think tank research organizations. All models are onboarded following MSCI ESG Research's vendor due diligence process. In all cases, the climate data are post-processed to derive hazard specific indicators. Post-processing includes steps such as bias-adjustment of climate projections and overlaying extreme sea level data with a digital elevation model to derive coastal flood inundation depths.

- **Vulnerability data:** Vulnerability factors and damage functions are obtained from various data sources, including historical disaster databases, such as EM-DAT[6] for tropical cyclones, the Munich Re database[7] for recorded wildfires, the European Drought Impact Report Inventory[8] (EDII) for river low flow events, and peer-reviewed scientific publications.[9]
- **Exposure data:** Relevant information about company asset characteristics such as location, size, or business activity are provided by the MSCI ESG Research's ALD. Asset value and revenue are estimated from the company's fixed asset values and total revenue using a disaggregation algorithm.[10]

4.3 MSCI ESG Research methodology governance

The ESG Methodology Committee (EMC) presides over the development, review and approval of all MSCI ESG Research methodologies, including Climate VaR.

MSCI ESG Research may update methodologies and models, including Climate VaR. Methodology update proposals may be subject to market consultation prior to approval for implementation by the EMC.

4.4 Data quality assurance (QA)

MSCI ESG Research considers a broad range of criteria when assessing the quality of input data used in ESG and Climate models. These criteria include completeness, exhaustivity, timeliness, accuracy, and traceability back to sources. The QA processes are designed in an additive setup, consisting multiple layers of automated validation and manual check points.

4.5 Model production cycle

MSCI ESG Research's Climate Risk Center has a quarterly model production cycle where significant code changes to its models, including Climate VaR are introduced, after the methodological changes have been vetted and approved by the EMC. These changes require an extensive and structured QA process that covers both the input data and the generated output data, to assure correctness of the models and their produced data.

All data auditing processes entail quarter-to-quarter statistical comparison of data to identify any possible outliers in the data sets. In case of any anomaly detection or abnormal changes, the issue is flagged and sent back to source for further evaluation and validation. Any model maintenance, methodology updates, and all statistically significant changes are disclosed to clients through quarterly release notes following high-level supervisory checks.

[6] EM-DAT (2008), 'EM-DAT: The International Disaster Database', Available at: https://www.emdat.be/, Last accessed June 13, 2024.

[7] Munich Re is a German reinsurance and insurance company covering and reporting on damages from a wide range of physical risks, among other risks.

[8] European Drought Centre 2015. "European Drought Impact Report Inventory (EDII) and European Drought Reference (EDR) database"

[9] For example, flood depth damage functions provided in Huizinga, J., Moel, H. de, Szewczyk, W. Global flood depth-damage functions. Methodology and the database with guidelines. 2017. EUR 28552 EN. doi: 10.2760/16510.

[10] More details can be found in the methodology document "Exposure Estimation for Physical Risk Models".

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