

Measuring and Managing Carbon Risk in Investment Portfolios

The transition towards a low-carbon economy has substantially accelerated in recent years. Spearheaded by the Paris Agreement in 2015, global actors have committed to address the risks associated with climate change by reducing global greenhouse gas (GHG) emissions.

Nonetheless, this disorderly transition towards a low-carbon economy introduces uncertain financial impacts originating from physical and transition risks. Considering the major impacts these risks can have, capital markets are starting to price in the potential profits or losses occurring from the transition process.

Among climate change-related risks, carbon risk can be considered the most far-reaching and thus the most deserving to be studied further. The most commonly used approach to analyzing and managing carbon risk in investment portfolios can be called fundamental: thresholds are set in portfolios for carbon-related firm-specific metrics such as CO₂ emissions. The key assumption behind this method is that the transition will have a larger negative impact on the value of companies with higher carbon footprints than on the one of companies with lower carbon footprints.

An alternative, more agnostic approach is proposed in this study, in the form of a market-based measure of carbon risk, a “carbon beta”.

Carbon Beta as the Market Measure of Carbon Risk

The carbon beta is derived from a Brown-Minus-Green (BMG) factor based on the Fama-French method. The factor is represented by the monthly return of a portfolio being long on brown stocks and short on green stocks, with the respective returns weighted by the market capitalization¹.

It is possible to distinguish two types of carbon betas. On one hand, the relative carbon beta can be positive or negative and it indicates whether the company benefits from being low-carbon or high-carbon (intuitively, an energy company has a positive relative carbon beta). On the other hand, a carbon beta's absolute value measures the magnitude of the sensitivity: a high absolute carbon beta implies a high impact of carbon risk on stock prices.

Having a market measure of carbon risk, i.e. the carbon beta, allows investors to have an exhaustive measure of the impact of the low-carbon transition on stock prices. The carbon beta is particularly useful insofar as it allows evaluating the carbon risk of a company by simply utilizing a time series of the company's stock price instead of a long list of variables assessing its environmental performance, as needed when calculating the carbon factor. Thus, it provides an essential tool for managing carbon risk when constructing investment portfolios.

Using this new framework, the carbon betas of the MSCI World Index components for the 2010-2018 period were analyzed; a universe of more than 1,600 stocks across 23 countries and 11 sectors². ■

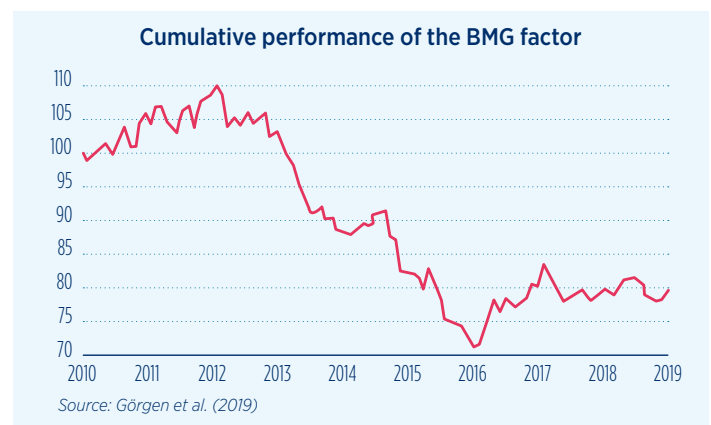
Key Findings

1- Green Stocks Outperformed Brown Stocks

Generally, the BMG factor mentioned above shows that brown firms slightly outperformed green firms from 2010 to the end of 2012. Then, until 2016, the cumulative returns of the brown-minus-green portfolio fell by 35%, due to the unexpected path towards the low-carbon transition, making green companies the real “winners”.

From 2016 until the end of the period analyzed, brown stocks outperformed again. One of the possible reasons behind this latter result is the absence of binding commitments or fiscal pressure mechanisms in the Paris Climate Agreement.

Overall, **best-in-class green stocks outperformed brown stocks over the period (2.52% annual excess performance)**.



1. The BMG factor was first developed by Görgen et al. (2019), Carbon Risk, SSRN, 2930897

2. Healthcare, Information Technology, Financials, Consumer Staples, Consumer Discretionary, Communication Services, Utilities, Industrials, Real Estate, Materials and Energy

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2- Carbon Risk Reflects Much More than a Company's Carbon Footprint

In opposition to the fundamental approach, a market measure of carbon risk considers other elements beyond a company's specific carbon footprint such as its sector, geography or corporate governance, all of which profoundly affect a company's resilience in the context of the low-carbon transition.

For example, if a company has a clear long-term strategy towards reducing emissions, the market will price in a lower carbon risk than for its industry peers.

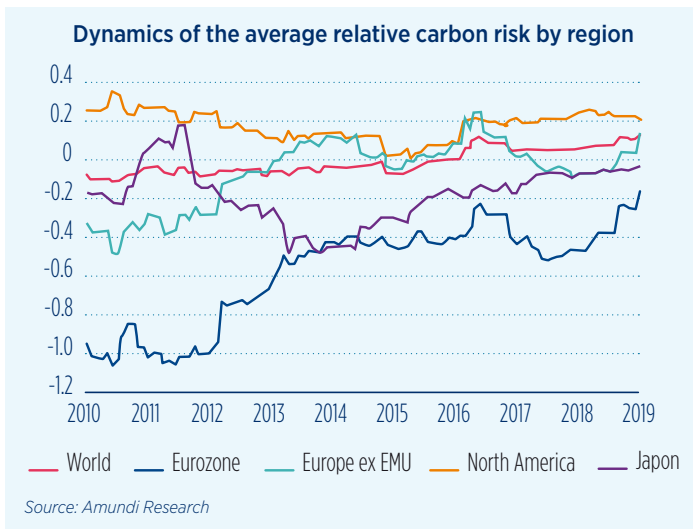
Two stocks with identical carbon intensities can have very different carbon betas: indeed, the study finds these two measures to be weakly correlated (linear correlation lower than 30%).

3- Geographies: Global Convergence and Shrinking Transatlantic Divide

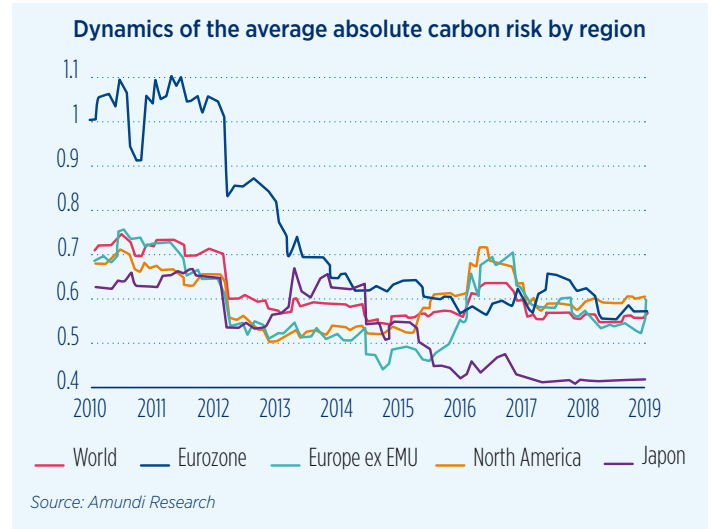
Presenting a positive carbon beta over the whole period analyzed, American stocks are undoubtedly negatively influenced by an acceleration in the transition towards a greener economy, whereas in the Eurozone, the opposite is true. In fact, the average relative carbon beta of stocks in the Eurozone is relatively lower than for any other region and it is always negative, although it has substantially increased and it is getting closer and closer to zero.

This can be interpreted as an initial over-pricing of carbon risk in the Eurozone due to major concerns for climate change impacts. Overtime, it has been converging with the rest of the world.

Another noticeable result is that the evolution of carbon risk does not seem to be driven by climate agreements in the short run, as mentioned above. **When commitments are not binding as in the case of the 2015 Paris Agreement, the market does not price in any significant future impact** and the relative carbon beta has thus not increased significantly.



Furthermore, the convergence of the absolute sensitivities to carbon risk in all the major geographic areas under analysis shows that investors are starting to see carbon risk as a global issue. Overall, there seems to be a normalization trend whereby the absolute carbon beta drops nearly everywhere with the market increasingly "incorporating" carbon risk. Japan is the only anomaly, where absolute carbon beta is around 25% lower than globally: an exception consistent with other ESG-focused studies³.



4- Sectors: Divergences, with Energy and Materials Cementing Their Carbon Risk Exposure

Contrarily to geographies, we do not see a convergence among sectors: investors should thus pay particular attention to them.

Energy, materials, real estate and industrials are negatively impacted by the transition process, as signaled by their positive carbon betas. Oppositely, healthcare, information technology and consumer staples, presenting a negative carbon beta, would benefit from the transition.

If we consider a dynamic analysis, it is possible to notice that healthcare, the only sector presenting a moderate negative carbon beta, has been getting closer and closer to becoming carbon risk-neutral, i.e. not benefitting nor losing from the transition.

Furthermore, sectors that have experienced a remarkable increase in their carbon betas are unsurprisingly energy and notably materials, that greatly diverged from real estate in the period analyzed.

3. See Amundi 2020 : The Alpha and Beta of ESG investing, or Amundi 2019: ESG Investing in Recent Years: New Insights from Old Challenges

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5- Reducing Carbon Intensity via Relative or Absolute Carbon Betas – The example of a Minimum Variance Portfolio

Carbon beta enables the inclusion of carbon risk constraints in the construction of minimum variance portfolios (MVP) as well as of enhanced index portfolios⁴.

Following the Global Financial Crisis (GFC), minimum variance strategies have aimed at avoiding any unrewarded risks, among which climate change-related ones can be included.

On one hand, considering relative carbon risk, that is, tilting a portfolio towards stocks that benefit from being low-carbon, we add a constraint representing a maximum carbon beta. In doing so, the MVP tends to select assets with low market risk and negative carbon risk. In order to have a reduction in the Weighted Average Carbon Intensity (WACI) of the portfolio, we can put a threshold to it: the final results suggest that **carbon intensity may be reduced without significantly increasing portfolio volatility**.

On the other hand, it is possible to utilize absolute carbon beta constraints: it consists of an “agnostic” approach through which we aim at having a carbon risk-neutral portfolio. In this case, the absolute carbon beta is naturally reduced during the optimization process without the need to choose an arbitrary constraint. Thus, market risk will determine whether the stock is included, whereas carbon risk will be “responsible” for adjusting the weight of the asset. In this case, the portfolio tends to overweight assets whose market and carbon risks are close to zero, such as stocks belonging to the Healthcare or Consumer Staples sectors.

It is relevant to clarify that the study does not claim the superiority of the market-based measure of carbon risk over the fundamental measure: the two approaches should not be considered as mutually exclusive but they should instead be used in a complementary way. The carbon beta can in fact be viewed as a forward-looking extension of the carbon intensity.

6- Carbon Beta as a Risk Management Tool

Previous Amundi studies on the relationship between ESG and factor investing have shown that ESG investing is indeed a beta strategy in the Eurozone while it can still be considered as an alpha strategy in North America⁵.

Nonetheless, one must be cautious about treating the carbon risk factor on a par with the ESG factor for the diversification of a portfolio in a factor investing perspective, in order to avoid a further widening of the “factor zoo”.

In fact, carbon risk, included in the Environmental pillar of ESG, represents a narrow investment type and cannot be regarded as a key investing theme for institutional investors, differently from ESG investing.

Thus, **this newly introduced market-based carbon risk measure, the carbon beta, is especially useful from a risk management perspective**. It provides an applicable measure of carbon risk that can be used in traditional portfolio construction methods, such as minimum variance strategies or enhanced index portfolios through a risk overlay or a bottom-up approach to control the carbon risk. ■

4. Amundi Research is currently working on a paper called “The market measure of carbon risk and its Impact on the Minimum Variance Portfolio”.

5. For further insights, see: “ESG & Factor Investing: A New Stage Has Been Reached” available at: <https://research-center.amundi.com/page/Expert-Talk/2020/05/ESG-Factor-Investing-a-new-stage-has-been-reached>

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