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Carbon Risk: Do Financial Markets Really Care?



Fabrizio Ferraro

Professor and Head of the Strategic Management Department at IESE Business School. He received his PhD in Management from Stanford University. His current research explores the emergence of responsible and impact investing in the financial sector.

"Climate risk is investment risk," stated Larry Fink, Chairman and CEO of BlackRock, in his [January 2020's Letter to CEOs](#). Climate change, he argued, was not only a social and policy issue, and capital markets had to assess its risks and shift capital allocation accordingly. As capital markets "pull future risk forward," this process had already started, and "sooner than most anticipate, there will be a significant reallocation of capital."

This statement was received with much skepticism both within the financial sector, and among environmental activists, prone to see most statements from investors as

mere greenwashing. Indeed, while it is easy to see why corporations and investors *should* take climate risk seriously, the long-term nature of the risk and the still relatively weak policy response might not induce them to *actually* do something about them.

Nevertheless, recently published rigorous empirical evidence suggests that financial markets have started to consider climate risk: stocks of corporations with higher carbon emissions have higher returns, which indicates that investors seek compensation for holding them and thus for their exposure to climate risk.

Climate Change

The latest assessment of the Intergovernmental Panel on Climate Change leaves no room for doubts: "It is unequivocal that human influence has warmed the atmosphere, ocean and land" (IPCC, 2021). Human activity has led to changes in temperatures unprecedented in the last 2000 years. Global surface temperatures were 1,09°C higher in the last decade than in the pre-industrial period (1850-1900). This exponential growth is set to continue and, under different scenarios, will lead to a temperature increase between 1,4°C and 4,4°C. Any of these scenarios would lead to dramatic changes in climate patterns, increasing the likelihood of

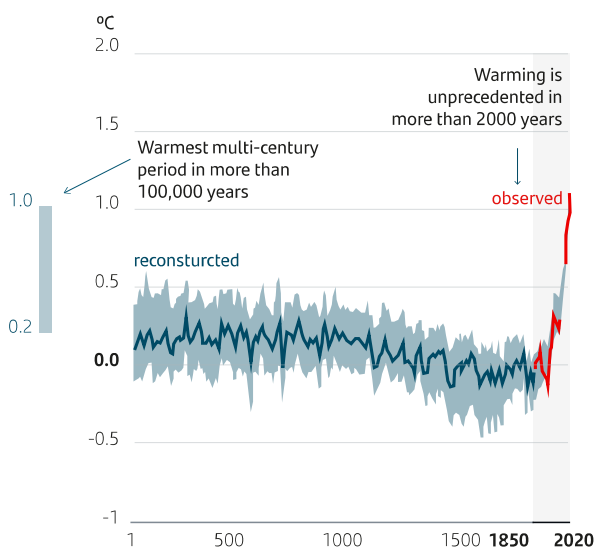
heat waves, heavy precipitations, and other extreme weather events. The sea levels would continue to rise, and all these changes would, in turn, affect biodiversity and agricultural activity. The geographic differences in impact are likely to cause social unrest and significant migration waves as some parts of the world might become inhabitable.

To mitigate the effect of global warming, 196 countries signed in 2015 the Paris Agreement, a legally binding international treaty to limit the temperature increase well below 2°C and preferably below 1,5°C. Staying below the 1,5° increase will not prevent all of the negative consequences of global warming but significantly reduce them and facilitate our adaptation.

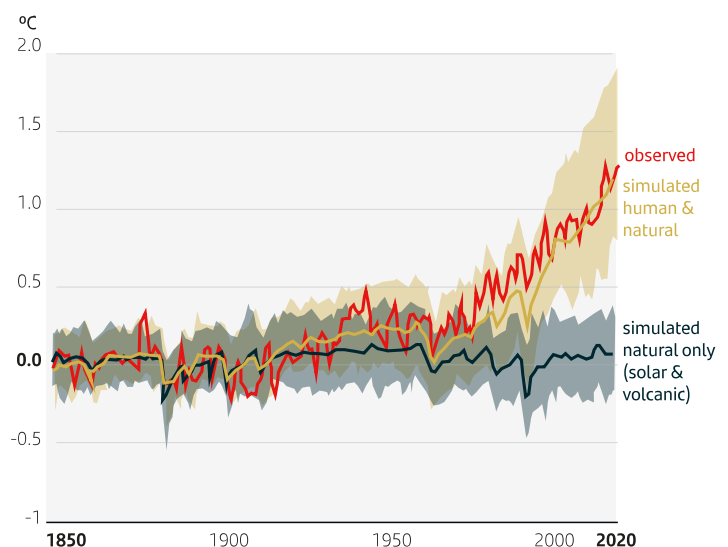
Changes in global Surface temperatura relative to 1850-1900

Source: IPCC, 2021

(a) Change in global surface temperature (decadal average) as **reconstructed** (1-2000) and **observed** (1850-2020)



(b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850-2020)



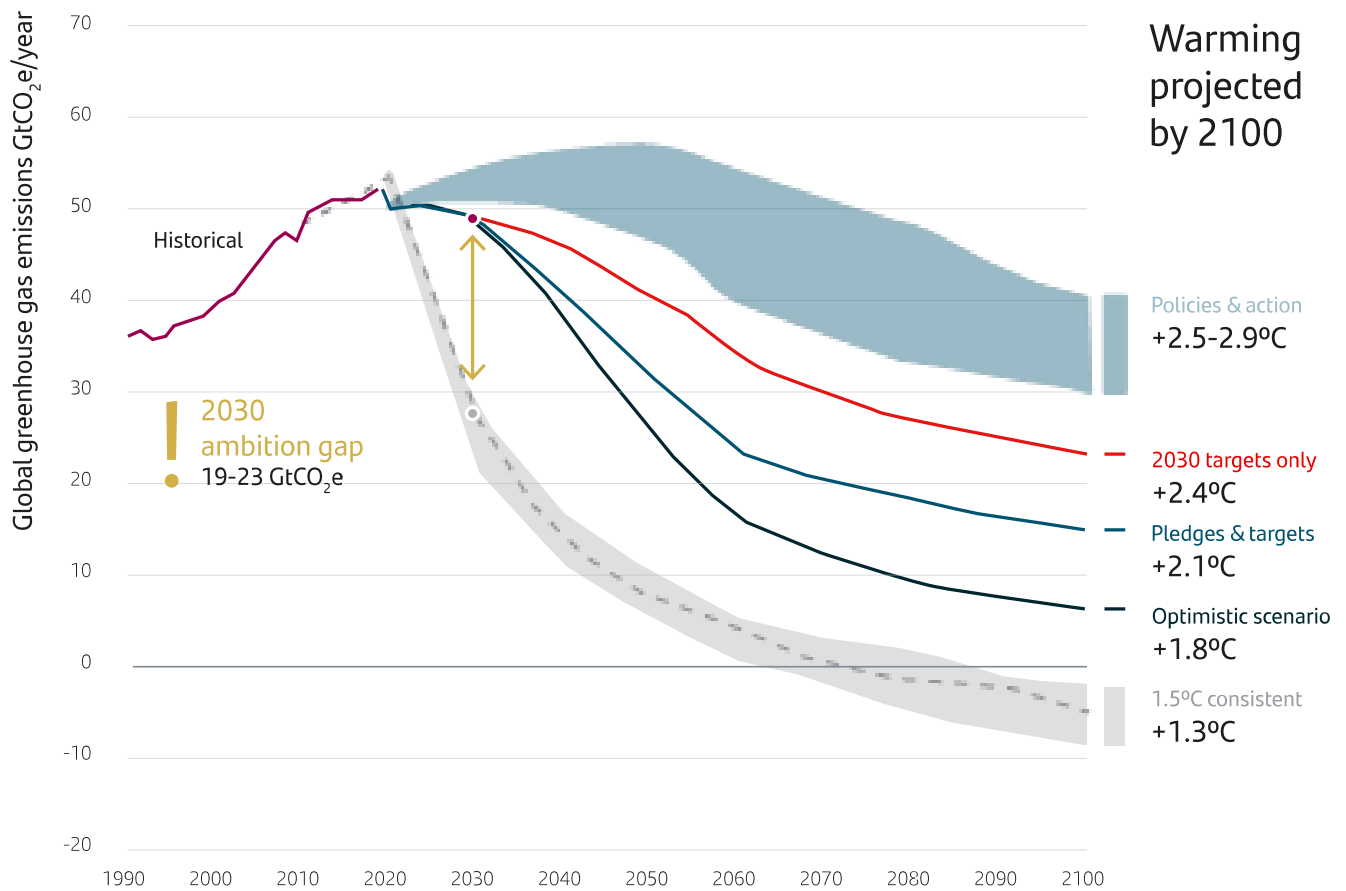
As global warming is driven by Carbon Dioxide (CO₂) and other greenhouse gases (Methane especially) emissions resulting from human activity, reaching the 1,5°C goal by 2100 will require massive reductions in emissions. Estimates from ICPP suggest that to achieve the 1,5° target, emissions in 2050 should be between 65% and 90% lower than in 2010 (ICCP, 2018). This translates into a global emission decrease of 7,6% per year. As a comparison, consider that when COVID-19 lockdown policies brought most societies to a halt in 2020, CO₂ emissions dropped 5,4% (only to come back up 4,9% in

2021). In sum, we would need a Covid-like reduction every year to achieve the 1,5°C goal.

Thus, it is not surprising that countries and firms have started to issue more aggressive decarbonization targets and net-zero commitments. Unfortunately, as the [Carbon Tracking NGO recently showed](#), even adding up all the public and private 2030 targets, we would be on track for a 2,4°C increase by the end of the century. And only if [ALL the new pledges made at the Glasgow COP26 conference](#) were actually implemented would we be on track for a 1,8°C increase.

2100 Warming projections - Emissions and expected warming based on pledges and current policies

Source: Climate Action Tracker, 2021



Climate Risk for Investors

The global financial sector will be affected by climate change in multiple ways. We can distinguish two types of climate change risks that will affect corporations and their investors: physical and transition. As climate change will lead to more severe weather events like flooding, droughts, and storms, its unfolding will inevitably change the physical conditions under which firms operate (climate physical risk). These changes will not be

homogeneous across regions and sectors, and firms will be affected regardless of their contribution to climate change in terms of carbon emissions.

Climate transition risk refers to the consequences firms, and investors will face as countries accelerate the adoption and implementation of policies to cut CO₂ emissions. Climate mitigation policies will asymmetrically affect different regions, industries, and firms, and while some might benefit, many others will face potential losses (and even potential bankrupt events).

Climate Risk

Climate-related risks are divided into two major categories:

Physical risks: Environmental consequences resulting from climate change can have financial and operational implications for firms directly and indirectly, such as the damage of a firm's assets or disruption of its supply chain. Physical risks can be event driven (acute) or long-term shifts in climate patterns (chronic). Investors should consider the location and scope of a firm's activities to understand at what extent performance will be hindered.



Source:

<https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf>

https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf

Transition risks: Transitioning to a lower-carbon economy implies broad policy, legal, technology, and market changes to mitigate and adapt to the impending requirements related to climate change. Investors should be aware of the nature, speed, and focus of these changes as they may imply different levels of financial and reputational risk to firms.

- **Policy risk:** Policy actions regarding climate change's mitigation and adaptation efforts are on the rise and continuously evolving.
- **Legal risk:** Recent increase in climate-related litigation claims for organizations that fail to mitigate impacts of climate change, adapt to climate change actions, or disclose material financial risks related to climate change.
- **Technology risk:** Firms may need to undergo technological transformation and innovation to comply with climate change policies.
- **Market risk:** Climate change may create a shift of supply and demand for certain commodities, products, and services.
- **Reputation risk:** Customer and community perceptions are changing and demanding firms to be responsible.

Climate transition risk can be proxied by a corporation's CO₂ emissions. The global public and private pledges to reduce emissions already require, directly or indirectly, drastic cuts in corporate emissions, and thus firms with higher emissions will have to cut more. Furthermore, as current reduction pledges will likely be insufficient, policies will likely be tighter, including carbon taxes, carbon-pricing mechanisms, phasing out of fossil fuel energy sources, and changes in land use. New technologies might render existing ones obsolete, and consumers might switch towards more climate-friendly products and services. Finally, some industries and corporations will face increasing reputational risk due to the stigmatization of their activities. Carbon transition risk is likely to be higher for corporations with higher emissions and those more emission-intensive. But are investors considering this risk in their decisions, or in other words, are financial markets pricing carbon risk?

Do Financial Markets Care? Pricing Carbon Transition Risk

Researchers have started to address these questions by exploring how stock returns vary with CO₂ emissions across firms and industries. The idea is that if investors are considering emissions as a risk factor, they are likely to demand a carbon risk premium to hold stocks of corporations with higher emissions. Thus these stocks would exhibit a higher return.

In two groundbreaking studies, [Patrick Bolton](#) (Columbia University) and [Marcin Kacperczyk](#) (Imperial College) showed that a global carbon-transition premium does exist and is economically meaningful. This premium is related to the level of emissions and their annual growth, controlling for other stock characteristics that predict returns and industry affiliation. The **level of emissions** can be interpreted as a long-term risk factor, as it measures how far each company is from net-zero carbon emissions. The **growth of emissions** can be interpreted as a measure of how fast the company is transitioning and thus can be considered a short-term risk factor from investors' point of view.

Corporate Carbon Footprint

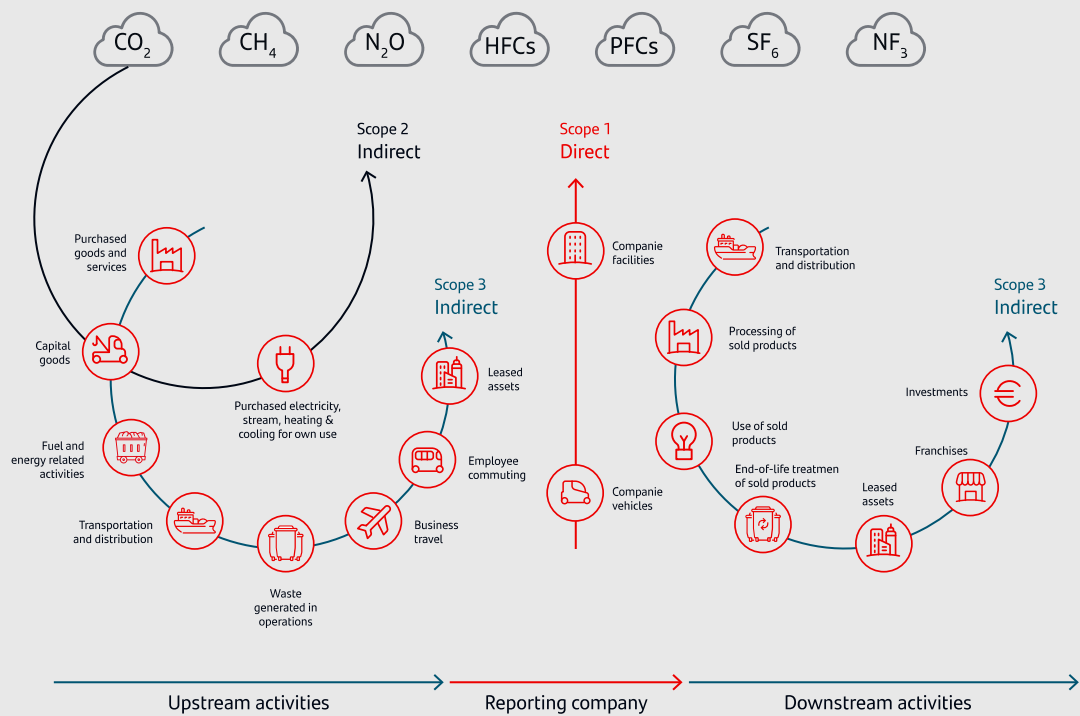
The emission of Greenhouse Gases (GHG) is the primary driver of climate change with CO₂ being the most prevalent one. The Corporate Carbon Footprint measures the amount of total GHG emissions generated by a firm's activities, directly and indirectly.

The GHG Protocol is the standard framework to account and report corporate GHG emissions which are categorized into three types:

Scope 1 refers to all direct GHG emissions from owned or controlled sources.

Scope 2 refers to indirect GHG emissions from consumption of purchased electricity, heat, or steam.

Scope 3 refers to other indirect emissions not covered in Scope 2 that occur in the value chain of the reporting company, including both upstream (mainly from supply chain and indirect operational activities) and downstream (distribution, storage, end-use, and disposal) emissions. Scope 3 emissions could include: the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g., transmission and distribution losses), outsourced activities, and waste disposal.



Source:
https://www.ghgprotocol.org/sites/default/files/ghgp/standards/Scope3_Calculation_Guidance_0.pdf
<https://ghgprotocol.org/>

This premium is related to both direct emissions (scope 1) and indirect emissions (scope 2 and 3). Overall, a one-standard-deviation increase in the level of scope 1 emission (an increase of 2,95 tons of CO₂ emissions) is associated with a 3,61% increase in stock returns (and thus a **3,61% annual carbon risk premium**). The same increase in scope 3 emissions (an increase of 2,22 tons of

CO₂ emissions) is associated with a return premium of **7,24%** per year. The short-term premium associated with growth in emissions is lower (but still significant): a one-standard-deviation change in scope 1 (a growth of 41,34% in emissions) and scope 3 emission (a growth of 25,74% in emissions) translate into return premia of 2,29% and 4,04% per year.

Bolton, P., & Kacperczyk, M. T. 2022. Global Pricing of Carbon-Transition Risk.

Source: Bolton and Kacperczyk, 2022.

Carbon Risk Premium

The higher returns investors expect for holding stock of high CO2 emitters

Stock Returns

The study uses monthly stock return of firms

Emission Intensity

The total amount of a firm's emissions relative to its sales, assets, or Kwh produced

Levels of Emissions

The total amount of emissions produced by a firm (scope 1, 2, and 3)

Changes in Emissions

The growth rate of a firm's total emissions (scope 1,2, and 3)

Time Period:

2005-2018

Sample:

14.468 firms

98% of publicly listed companies (in market capitalization terms) that report emissions data

Geographical scope:

77 countries (North America, Europe, Asia, and Africa, Australia and South-America labeled as Other)

Data Sources:

Primary databases:

Trucost Annual data on firm-level carbon and other GHG emissions.

FactSet Stock returns and financial data from firms.

Other databases

World Bank: Country-level data.

Germanwatch: Global climate policy index and climate risk index data.

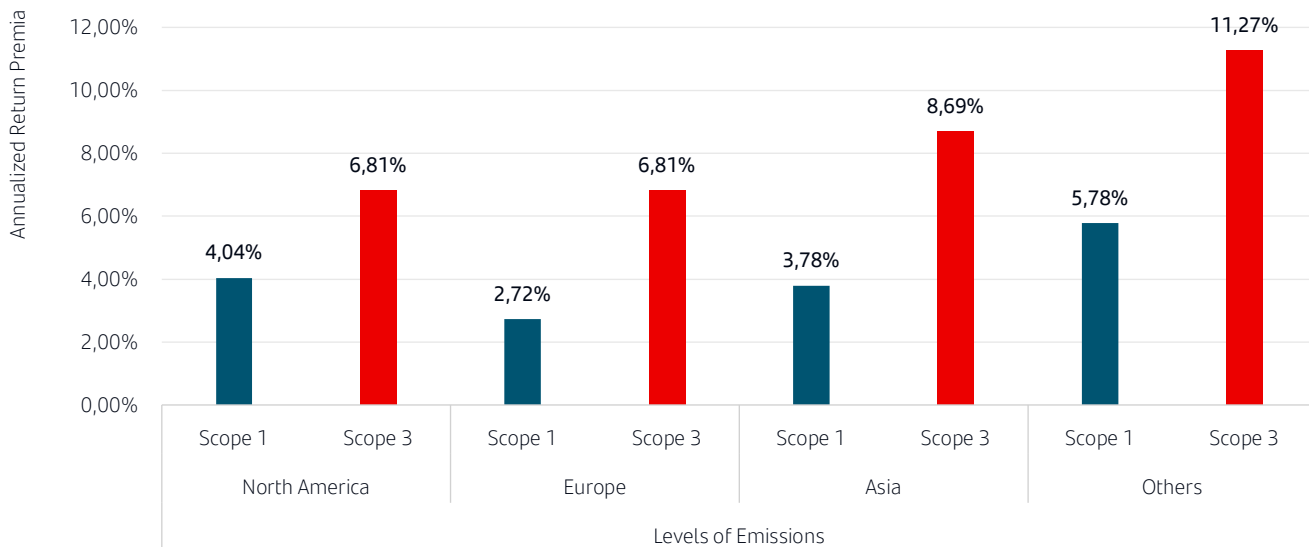
Morgan Stanley: MSCI World Index data.

The carbon risk premia can be observed across North-America, Europe and Asia, but its magnitude is different across regions. These differences might signal different views of investors on the extent to which firms are exposed to climate transition risks in each region. One interesting result is that, after controlling for industry effects, the carbon premium for emission growth is not significant in Africa, Australia, and South America (which the authors aggregate as Others). This might reflect the fact that countries in these regions are (or are perceived to be) less active in developing policies to accelerate the climate transition.

When comparing risk premia across countries, they find that **more democratic** countries have lower carbon premia. As the carbon transition will be dramatic in the energy sector, it is not surprising that countries with a higher **share of renewable energy** sources exhibit lower carbon premia, while countries with greater **dependence on the energy sector** have higher premia. Finally, countries with **tighter climate policies** also exhibit higher carbon premia.

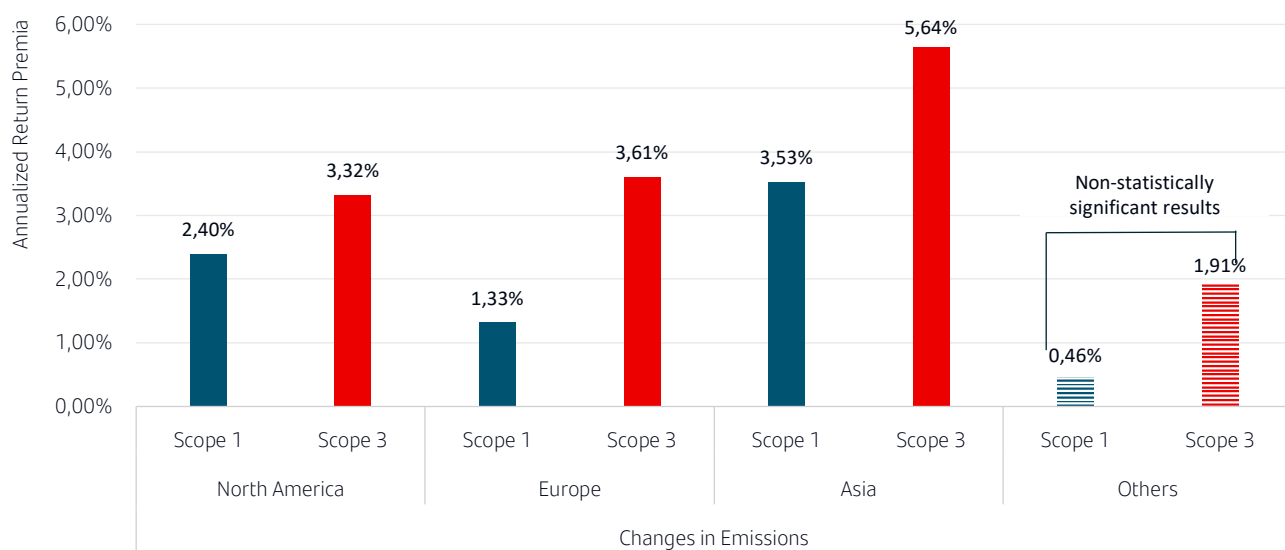
Regional Carbon Premia per Level of Emissions by Scope (Long-term Risk)

Source: Author's elaboration based on Bolton and Kacperczyk, 2022



Regional Carbon Premia per Changes in Emissions by Scope (Short-term Risk)

Source: Author's elaboration based on Bolton and Kacperczyk, 2022



In a related study focused solely on the United States, the authors also examine whether the carbon premium is associated with the **emission intensity (relative to sales)**, and somewhat surprisingly, did not find any association.

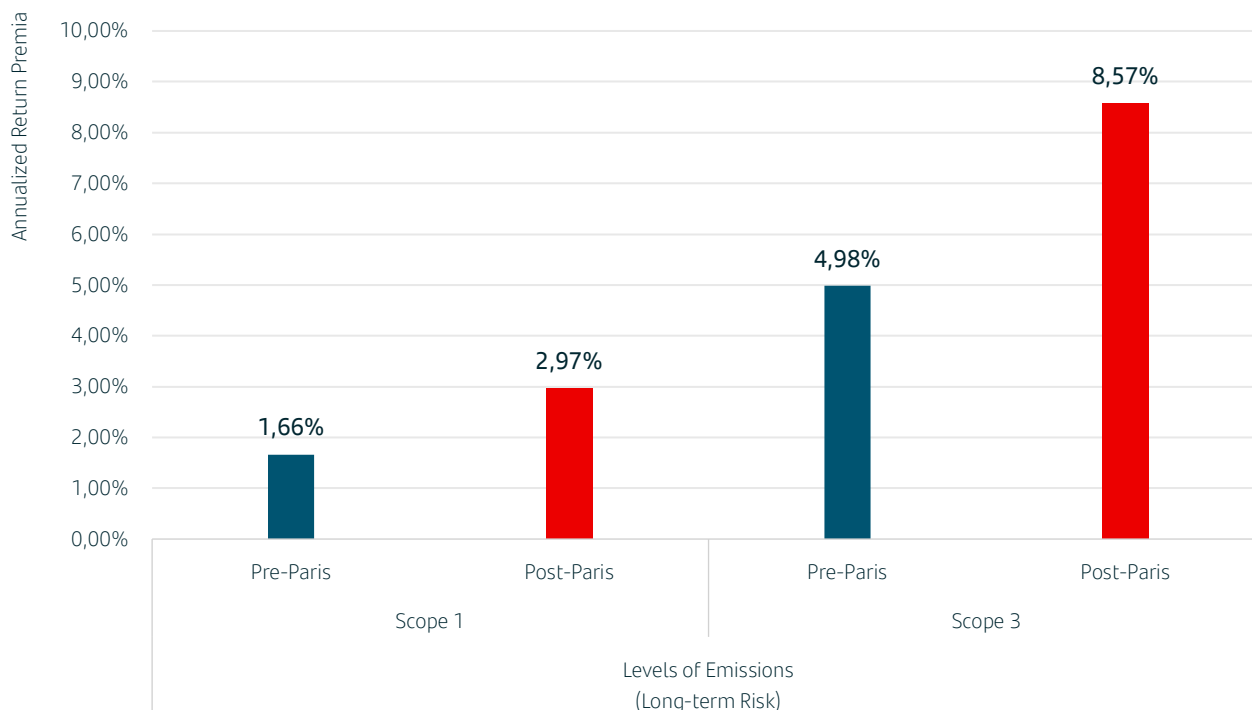
This is surprising because emission intensity is often used to consider the exposure of a firm to the climate transition, and it is at the basis of the construction of low carbon indexes (see [MSCI Low Carbon Indexes](#), for instance). Nevertheless, what we need to achieve Net-

Zero is a reduction in total emission, and most policy responses are likely to target the level of emissions rather than its intensity.

What is driving investors to integrate carbon risk in their decisions? By comparing returns before and after the 2015 Paris Agreement, the study shows that investor awareness of transition-carbon risk is higher after this event.

Global Carbon Premia by Scope (Pre vs Post Paris Agreement 2015)

Source: Author's elaboration based on Bolton and Kacperczyk, 2022



Investors thus have started to consider climate transition as a risk factor. But not all investors are doing it consistently. In a study focused on the US stock market, the authors also show that insurance companies and pension funds tend to hold less stocks of firms with higher scope 1 emissions. This is consistent with the recent trend towards divestment from carbon-intensive industries, even though the authors suggest that divestment cannot explain much of the premium.

A New Risk Factor?

What do these results mean for investors? On the one hand, the immediate take-away is that investors should consider climate change (or at least climate transition) a novel risk factor to integrate in their valuation models. Of course, investors with different time horizon and risk appetite might end up taking different decisions on the basis of the analysis. Indeed, short-term focused investors might see these results as an arbitrage opportunity, accepting to hold stocks that other longer-term investors are shunning, and thus reaping higher returns. But what PRI calls the "[inevitable policy response](#)" might arrive earlier than expected and thus put arbitrageurs in a difficult situation.

Africa, Australia, and South-America might also present an opportunity, as it seems that investors have so far underestimated climate transition risk for firms in those countries. As one of the studies mentions, financial markets appear not to be globally integrated. It would be interesting to evaluate the extent to which [the policies emerging out of Glasgow COP26](#) are urging now investors in these regions to weigh more the climate transition risk they are talking.

More research is needed on climate risk, and while the work discussed already show that financial markets are pricing this risk somehow, more work is needed. So far most of the work has focused on transition risk, given the lack of comparable data on the physical risk. As more data becomes available on corporate climate physical risk, we should study whether this risk is priced differently by markets. Furthermore, more research should explore the divergence between the results on level vs. intensity of carbon emissions and the extent to which investors are integrating both in their decisions. Particularly interesting would be the exploration of the extent to which the engineering of carbon intensity in the indexes might be generating capital reallocation that might not be effective in mitigating climate transition risk.

To Learn More

- Bolton, P., & Kacperczyk, M. T. 2021. Do Investors Care about Carbon Risk? Journal of Financial Economics, 142 (2): 517-549 [Read more](#)

Available at: [Read more](#)

- Bolton, P., & Kacperczyk, M. T. 2022. Global Pricing of Carbon-Transition Risk. National Bureau of Economic Research – Working Paper 28510. [Read more](#)

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[Global pricing of carbon-transition risk](#) [Read more](#)

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