

Climate scenarios and low-carbon targets of companies: A theoretical approach on alignment strategies and market equilibrium

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Abstract

This paper introduces a two-phase model formalizing the concept of alignment to a climate scenario within an economy of publicly traded companies and investors. During the first phase, companies must make a choice between announcing their commitment to low-carbon target, which compels them to abate their emissions, or refusing to make any announcement. Their decision is based on a required minimum level of abatement and on their ability to abate their greenhouse gas emissions. In the second phase, investors make their portfolio allocation decisions based on the companies' announcements, which provide signals on the long-term climate risk exposure of stocks. We show that companies with the highest abilities always have profit opportunities to commit to low-carbon targets. We also identify a cost to announcing a low-carbon target. Finally, we show that the investors' climate preferences are essential to maximizing the number of companies committing to low-carbon targets.

Keywords: Climate scenario, Alignment, Low-carbon target, Climate risk premium, Asset pricing

JEL Classification: D21, D53, G12, Q54

1 Introduction

The concept of “alignment” to a climate scenario¹ has become a mainstream tool both for companies and for investors since the Paris Agreement (Watson et al., 2023; Black et al., 2021). Initially developed in climate science and macroeconomics with the DICE (Dynamic Integrated Climate-Economy) model (Nordhaus, 1993), climate scenarios have since started to appear in the business world, along with alignment strategies. Even though there is no formal definition for the concept of alignment, it is generally considered as a set of measures in order to follow a certain future scenario (Cochran et al., 2019). Alignment can apply to a simple scenario: a projection of anthropogenic emissions over a given period of time, called a carbon budget², determines a temperature rise of the climate system (Friedlingstein et al., 2022). A more sophisticated scenario aims to determine the projection of greenhouse gas emissions from an exhaustive set of social and economic parameters, and from policies on the management of greenhouse gas emissions (O’Neill et al., 2017; Lee and Romero, 2023).

For a company, setting-up a strategy to align to a climate scenario, especially to a scenario where greenhouse gas emissions are abated, is one of the ways to communicate to investors how the company intends to manage its climate risk³ (Fernandez-Feijoo et al., 2014; Haleem et al., 2022). This information is useful for an investor, as it brings a long-term indicator of the financial risk of a firm, providing a solution to the issue of short-termism, which leads to inaction regarding the company’s greenhouse gas emissions (Slawinski et al., 2017). A company aligns its strategy to a given climate scenario (Burke, 2019) by committing to a low-carbon target, which we define as a projection of the company’s future greenhouse gas emissions, adapted from the climate scenario. There are several objectives behind committing to a low-carbon target: to lessen the impact on climate change, to increase customer demand, and to attract investors (Flammer, 2012; Chen et al., 2019; Bolton and Kacperczyk, 2021a). Attracting customers and investors can also lead to greenwashing practises, where environmental disclosure does not reflect real performance (Lyon and Montgomery, 2015) and commitment targets are purely symbolic.

Multi-stakeholder initiatives, such as the Science-Based Targets initiative (SBTi), play an important role in accelerating the commitment of firms to low-carbon targets (de Bakker et al., 2019; Nikolaeva et al., 2023). These organizations, with a governance joining both business and societal participants, have the common objective of helping firms to build low-carbon targets which are achievable by firms while following specific climate scenarios (Fransen, 2012). It has

¹The climate scenario is defined as a “plausible representation of future climate that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change”, see Mearns et al. (2001).

²Maximum amount of cumulative net global anthropogenic greenhouse gas emissions that would result in limiting global warming to a given level with a given probability, see Friedlingstein et al. (2022).

³Climate risk is defined the negative impact of climate change on corporations (Institute, 2021).

been shown that a firm’s participation in such initiatives contributes positively to the mitigation of its climate risk (Romito et al., 2023).

Firms are increasingly announcing low-carbon targets, but this only reflects an expected future performance. There is a given uncertainty as to whether a company will successfully reach its target. The probability of success depends on the initial ambition of the low-carbon target, and the firm’s capacity of abating its emissions. This represents a financial risk for the investor: if a firm fails to achieve its initial target, it faces an increased exposure to climate risk (Carney, 2015). Moreover, the company can be accused of falsely assessing its transition risk, which will be brutally revised, menacing its financial performance due to possible investor rejection and decreased customer demand.

The notion of alignment extends to financial portfolios, and is used to measure the portfolio’s future exposure to climate risk (Giese et al., 2021). Many investors focus on integrating climate risks in their investment decisions, as they draw utility not just from financial returns, but also from contributing to the abatement of greenhouse gas emissions (Hartzmark and Sussman, 2021). They primarily rely on extra-financial performance data, such as companies’ greenhouse gas emissions, provided by the companies themselves or by third parties (Eccles et al., 2017; Walter, 2020). The alignment of a financial portfolio can be assessed with metrics such as Implied Temperature Ratings, however these remain hard to formalize due to a lack of common methodology (Raynaud et al., 2020). More straightforward approaches have been developed in order to build low-carbon portfolios, in which a scientifically-defined carbon budget serves as a constraint for the allocation of assets (Bolton et al., 2022). This approach has the advantage of being simple from a theoretical point of view and easy to implement.

The impact of abatement efforts on financial returns remains empirically uncertain. It is generally recognised that a higher abatement increases customer demand (Dai et al., 2021; Meier et al., 2022) and decreases the cost of capital (Hong and Kacperczyk, 2009; Krüger, 2015; Bolton and Kacperczyk, 2021b). Several theoretical models have been developed to include the environmental performance (mostly using greenhouse gas emissions as representative metrics) of companies into their stock prices (Pástor et al., 2021; Pedersen et al., 2021; Avramov et al., 2022; Zerbib, 2022). These models include climate preferences for the investor, which depends on an aggregated score for the company, representing its current performance, and an climate taste function for the investor.

However, to date, there is little theorization on the alignment of a company, the subsequent alignment of a portfolio and the financial performance of both. The choice of a company to commit to a low-carbon target has not been approached theoretically, although it is an important issue when the current objective is to accelerate the transition to a low-carbon economy.

Furthermore, existing theoretical models on the relation between climate risk and financial performance have not modelled the impact of committing to a low-carbon target. They translate the current climate risk of a firm, but do not take into account the future exposure to climate risk.

The main objective of this paper is to contribute theoretically to the literature on alignment to climate scenarios. We start by formalizing climate scenarios and alignment through low-carbon targets. We define a climate scenario through a decarbonization rate associated to a carbon budget. We adapt the concept of portfolio alignment at the firm level, which provides comparability over the future exposure to climate risk of the firm's assets.

We go on to apply the concepts of climate scenario and alignment to an economic model in two phases, where in the first phase firms must take a strategic decision on abating their emissions at a rate of their choice or not making abatement efforts by committing to low-carbon targets. We introduce the concept of decarbonization ability (Crifo and Sami, 2008) as a key element in the model, representing the companies' capacities to abate their emissions. We show that companies choose their targets following profit opportunities from the low-carbon targets, a result consistent to corporate finance literature (Cornell and Damodaran, 2020), and that their decision depends on their own decarbonization abilities and the shifts in customer demand for sustainable products.

The second phase of the model focuses on a group of investors which invest in the companies' stocks and take portfolio allocation decisions based on the companies' low-carbon target choices. Indeed, the climate strategy announcement of firms can be translated as a financial long-term risk. The demand for stock not only depends on the return of a stock, but also on its exposure to climate risk through a climate risk premium, and on the investor's own climate preferences. This follows a strand of literature on asset pricing, where the climate preferences of investors are included in the models (Pástor et al., 2021; Pedersen et al., 2021; Avramov et al., 2022; Zerbib, 2022). However, contrary to previous research, the allocation decisions depend on the future exposure of a stock to climate risk, and not the current performance of companies. The choices of companies and the allocation of investors provide market-clearing conditions and equilibrium stock prices.

There are three main results to our model: first, companies with the highest abilities to abate their emissions will always have better opportunities to commit to a low-carbon target, but this is not necessarily the case for firms with lower abilities, which are more exposed to climate risks (Bolton and Kacperczyk, 2021b). Second, we show that there is an announcement cost when a firm decides to announce its commitment to a low-carbon target: a failure to reach the target, especially an easy one can result to worse damages to the firm's reputation

than if the company does not committed to any target. Finally, we show that the number of companies committing to a low-carbon target can be optimized, and that the optimization conditions depend on the average greenhouse gas abatement efforts required to stay within a carbon budget, the investors' preferences and the level of ambitions of market leaders (with the highest decarbonization abilities) when they commit to a low-carbon target.

The rest of the paper is organized as follows: section 2 formalizes the carbon budget and low-carbon pathways. Section 3 details the two-phase model, section 4 studies the market equilibrium that appears under the market clearing conditions and section 5 concludes and discusses our results.