Asset pricing under transition scenario uncertainty

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Risks and opportunities related to environmental transition are usually evaluated through the use of scenarios, produced and maintained by international bodies such as the International Energy Agency or the Network for Greening the Financial System (NGFS). This approach assumes perfect knowledge of the scenario by the agent, but in reality, scenario uncertainty is an important obstacle for making optimal investment or divestment decisions. In this talk we present two studies of the impact of transition scenario uncertainty on the optimal financial decision-making and asset pricing.

In the first study, we develop a real-options approach to evaluate assets and potential investment projects under dynamic climate transition scenario uncertainty. We use off-the-shelf Integrated Assessment Model (IAM) scenarios and assume that the economic agent acquires the information about the scenario progressively by observing a signal, such as the carbon price or the greenhouse gas emissions. The problem of valuing an investment is formulated as an American option pricing problem, where the optimal exercise time corresponds to the time of entering a potential investment project or the time of selling a potentially stranded asset. To illustrate our approach, we employ representative scenarios from the NGFS scenario database in two energy-related examples: the divestment decision from a coal-fired power plant without Carbon Capture and Storage (CCS) technology and the potential investment into a green coal-fired power plant with CCS.

In the second study, we develop a structural model for pricing a defaultable bond issued by a company subject to climate transition risk. We assume that the magnitude of the transition risk impacts depends on a transition scenario, which is initially unknown but is progressively revealed through the observation of the carbon price trajectory. The bond price, credit spread and optimal default/restructuring thresholds are then expressed as function of the firm's revenue level and the carbon price. Numerical implementation of the resulting formulas is discussed and illustrated using real data. Our results show that under transition scenario uncertainty, carbon price adjustments are more likely to trigger a default than when the true scenario is known because after each adjustment the more environmentally stringent scenario becomes more likely. We also find that faster discovery of scenario information leads to higher credit spreads since better information allows the shareholders to optimize the timing of default, increasing the value of default option and decreasing the bond price.