"Analyzing energy commodities and the EU ETS: strategies for managing shocks and hedging in the low-carbon transition"

This thesis investigates the dynamic interplay between energy commodities and the European Union Emissions Trading System (EU ETS), offering new insights into how these markets respond to regulatory and economic shocks during the ongoing transition to a low-carbon economy. Through three distinct but interrelated studies, it addresses critical issues such as the propagation of market shocks, investor behavior leading to market anomalies, and the development of effective financial hedging strategies that align with environmental goals.

The first study examines the transmission of shocks across a comprehensive system of energy commodities, including fossil fuels, their derivatives, and European Union Allowances (EUAs). By applying advanced econometric techniques, such as spillover analysis in both time and frequency domains, this study provides a detailed view of how shocks originating from upstream (raw materials like oil and natural gas) or downstream (derivatives like gasoline and heating oil) energy markets propagate across the system. The analysis spans normal market conditions and periods of crisis, such as the COVID-19 pandemic and the Russia-Ukraine conflict. Results show that raw materials consistently act as dominant transmitters of shocks, especially during crisis periods, which amplifies market volatility. The study highlights the policy need for greater market oversight and more robust mechanisms to prevent the cascading effects of crises on energy markets, ensuring a more stable and secure energy supply during global disruptions.

The second study focuses on herding behavior in the stock prices of firms regulated by the EU ETS. Herding occurs when investors mimic the behavior of others rather than relying on independent judgment, which can lead to inefficient pricing and increased market volatility. The study explores the relationship between herding behavior and spillovers in energy commodity markets, revealing that herding intensifies during periods of high market volatility and connectedness, such as regulatory changes or external shocks. This behavior distorts carbon prices, undermining the core function of the EU ETS, which is to reflect the true marginal cost of reducing greenhouse gas emissions. To address the financial implications of this behavior, the study proposes a novel buy-sell trading strategy that incorporates both market volatility and spillover data to detect periods of heightened herding. The strategy identifies market conditions where herding is most likely and adjusts investment positions accordingly. The results of this strategy demonstrate superior risk-adjusted returns compared to traditional approaches such as equally weighted buy-and-hold portfolios and minimum connectedness portfolios. Specifically, the strategy was found to perform particularly well during periods of high market volatility, offering better protection against downside risks while taking advantage of the clustering effect of investor behavior. The practical application of this strategy suggests that combining market volatility with spillover information can yield profitable outcomes while also reducing the risks associated with irrational investor behavior. This insight is valuable for both asset managers and investors seeking to optimize their returns in volatile carbon markets.

The third study proposes the development of a novel equity climate index based on the environmental performance of firms regulated by the EU ETS. Unlike traditional ESG indices or Scope emissions, which often suffer from inconsistent and self-reported data, this index is grounded in verified emissions data, providing a more accurate measure of firms' carbon footprints. The research shows that this index offers superior hedging properties against a basket of financial assets, including stocks, bonds, commodities, and EUAs, particularly during the stricter regulatory phases of the EU ETS (Phases III and IV). However, the study notes that hedging with the climate index can be more costly compared to traditional financial instruments, although it provides better alignment with environmental objectives. This index offers a valuable tool for investors seeking to balance financial returns with sustainability goals, by investing in companies actively reducing their carbon emissions.

In conclusion, this thesis provides a robust empirical analysis of energy commodities and the EU ETS, offering valuable insights for policymakers, investors, and market participants seeking to navigate the challenges of the low-carbon transition. By addressing key issues related to market spillovers, herding behavior, and financial hedging, this research contributes to the development of more effective climate policies and sustainable investment strategies, ultimately supporting the global shift toward a greener economy.