Modeling Volatility in the US Energy Sector In Response to Global Climate Change Sentiment

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Background and Motivation

Campos-Martins and Hendry (2024) devise a method to measure how the volatility of the global Oil and Gas industry is affected by global climate change sentiment. We focus on how the US O&G industry is specifically affected by global climate change sentiment. We consider XLE to be a proxy for the U.S O&G industry as it is made up of the biggest O&G firms, such as ExxonMobil and ConocoPhillips. We study how the Energy Sector Fund (XLE) reacts to global climate change sentiment. Our method of analysis includes incorporating the predicted volatility from a GARCH model to analyze the short and long run effects of the shock through a Local Projection IRF model.

Variables Used for Model

To build the model, we use the following variables:

- **Inflation Adjusted XLE Returns**
- **Index** Broad measure of negative coverage on climate change, focused on research, policy and climate events
- **S&P** Stock benchmark based on 500 large US companies
- **NASDAQ** Stock benchmark based on 100 global companies, with strong focus on tech
- **WTI** US benchmark for crude oil price
- **Brent** European benchmark for crude oil price
- **Government Spending** Percentage change in US fiscal policy

GARCH-Controlled LP IRF Model

We start by running a GARCH (1,1) model for the conditional variance of the returns:

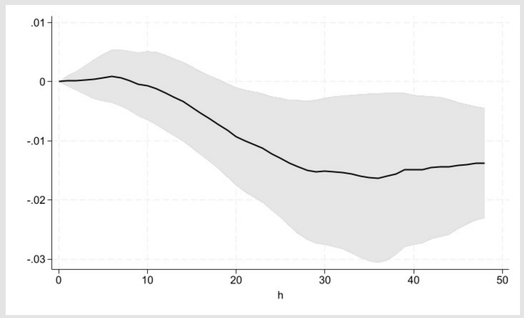
$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1} + \beta_1 \sigma_{t-1}^2$$

After predicting the conditional standard deviation from this model, we use it as our dependent variable of interest in the LP IRFs specified by:

$$\hat{\sigma}_{t+h} = \theta_h Index_t + \boldsymbol{controls_t} + \nu_{t+h}$$

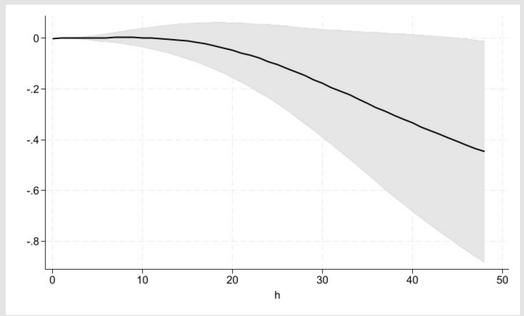
The IRFs are then generated and significant effects are measured.

Index Shock on Volatility



Forecast Horizon	Coefficient
⋮	⋮
F19	-0.0082*
F20	-0.0092*
F21	-0.0100*
⋮	⋮

Index Shock on Cumulative Volatility



Forecast Horizon	Cumulative Volatility
⋮	⋮
F47	-0.4338*
F48	-0.4475*

Potential Mechanisms

The effect that global climate change sentiment shocks has on the volatility of the XLE fund contradicts the findings in the Campos-Martins & Hendry paper. Since exchange-traded funds (ETFs) are used to hedge against idiosyncratic risks, this behavior could be isolated to the XLE fund.

We believe the decrease in volatility comes from investors and firms hedging risk in order to minimize the effect the news will have on the energy sector. The decrease comes later as the global news would take time to affect American markets directly, either through policy changes or economic barriers.

There is literature that suggests investors switch to green stocks that give higher returns and hence there is less speculation in brown stocks, which drives lower volatility in the XLE fund.

Limitations and Extensions

Our data for fiscal expenditure and climate change sentiment required linear interpolation to make them monthly. This likely affected our results by introducing artificial smoothness. One way to fix this would be to consider a MIDAS-GARCH model which considers data at different frequencies.

To see the effect of climate change policies on the volatility and returns of the same fund, it would be interesting to look at how specific US climate policies affects the volatility and returns. The combination of time series and causal inference could help identify the short and long-term market effects it can have.

References

[1] Campos-Martins, S., & Hendry, D. F. (2024). Common volatility shocks driven by the Global Carbon Transition. *Journal of Econometrics*, 239(1), 105472.

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[3] Li, H., Bouri, E., Gupta, R., Fang, L. (2023). Return volatility, correlation, and hedging of green and brown stocks: Is there a role for climate risk factors? Journal of Cleaner Production, 414, 137594.

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