Forecasting Carbon Dioxide Price Using Statistical Learning Methods

Pauline Barrieu, George Tzougas,
Chenyan Lyu, Dimitris Christopoulos, Despoina Makariou

Problem statement

- The carbon market has been recognized as an effective platform for the international community to solve climate problems and reduce pollution emissions.

- Long-term goals for developing regional or nationwide Emission Trading System (ETS) would be to create a larger, integrated, and more liquid carbon market.

- Financial flows between jurisdictions can be politically contentious, which impose high complexity of regulations.

- Understanding the pricing mechanism of the carbon market based on efficient forecasting methods can address the aforementioned.

Research goal

- Construct hybrid Machine Learning-Time Series models for capturing the stylized characteristics of the carbon market and for improving efficiency and robustness for forecasting carbon prices.

- Benchmark to time-varying, high-order moment benchmark models that have been traditionally used in fitting the carbon price series with time-varying, high-order moment volatility characteristics.

Research methodology

- Incorporate the time-varying impact of asymmetric information and extreme factors onto the forecasting model in order to help investors formulate investment strategies and aim at reducing carbon emissions and provide evidence to explain the carbon premiums.

- For the variable of carbon assets we consider continuous futures contracts from both EU and UK data sets.
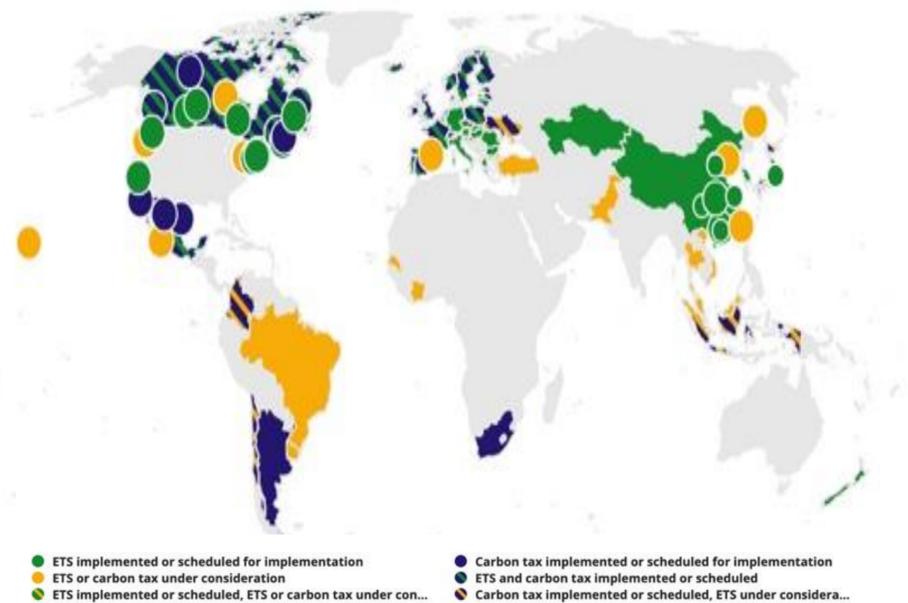
Impact

- Efficient carbon price forecasting can enable the carbon market to reduce the global carbon dioxide emissions for a sustainable human society and economic growth.

- Examine whether the EU carbon price has an impact on the UK price. Does quitting EU ETS make UK's carbon price a premium? whether the overlapping price widens or narrows the pollution exposure gap between low-income populations and other communities?

In April 2022, the monthly average CO_2 concentration was 420.02 ppm which is the highest levels on record since observations began in 1958.

Excess of CO_2 in the atmosphere boost global average temperatures and the probability of surpassing the 1.5C limit of the Paris Agreement within the next 5 years is 50%.

The steady march of methodological innovation on carbon price forecasting mainly focuses on the price information transmission and volatility modeling and does not account for the time-varying impact of asymmetric information.

Summary map of regional, national and subnational carbon pricing initiatives

- ETS implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS implemented or scheduled, ETS or carbon tax under con...
- Carbon tax implemented or scheduled for implementation
- ETS and carbon tax implemented or scheduled
- Carbon tax implemented or scheduled, ETS under considera...

Source: The World Bank, Data last updated April, 01 2021

Hybrid neural networks-time series models are more likely to succeed

Input Layer | Hidden Layer #1 | Hidden Layer #2 | Output Layer