WIND ENERGY, THE PRICE OF CARBON ALLOWANCES, AND CO2 EMISSIONS: EVIDENCE FROM IRELAND

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Overview

Increased reliance on renewable energy is an important component in the European Union's action plan for reducing carbon emissions. Another key instrument is the European Union's Emission Trading System (EU ETS) which caps the overall level of emissions and then permits trade among the emitters.

While the shift from fossil fuels to renewable energy is widely accepted by those who recognize the challenge posed by human induced climate change, the EU ETS is not without controversy. Some claim simply that it is immoral to buy and sell rights to pollute. Others allege that the EU ETS is ineffective because the market for allowances is vulnerable to speculation.
Using data from Ireland, this paper examines the effects of wind energy and the EU ETS on carbon emissions from electricity generation

Methods

The analysis employs a time-series econometric model of CO_2 emissions for each half-hour over the period 1 January 2015 through 31 December 2016. Explanatory variables include a weighted measure of the carbon allowance price, the MWh equivalent fuel price of coal relative to the MWh equivalent price of natural gas, the share of load accounted for by wind energy generation, along with measures of expected vs realized electricity load, the error in the wind energy forecasts, and the ex post vs ex ante system marginal electricity price. The model is estimated using standard ARCH/ARMA methods with an allowance for "fat tails."

Results

Results indicate that increases in the carbon allowance price have a nontrivial negative effect on carbon emissions, depending on the share of load accounted for by wind energy. Findings also indicate that higher wind energy penetration levels have a large negative effect on emissions.

We conducted an out-of-sample analysis using half-hour data over the period 1 January through 31 December 2017. Over this out-of-sample period, the predictive R^2 equals 0.985 when all the parameter estimates, including AR, MA, ARCH, and conditional terms are considered (Figure 1). We believe that this out-of-sample performance is an encouraging indicator of the model's adequacy.

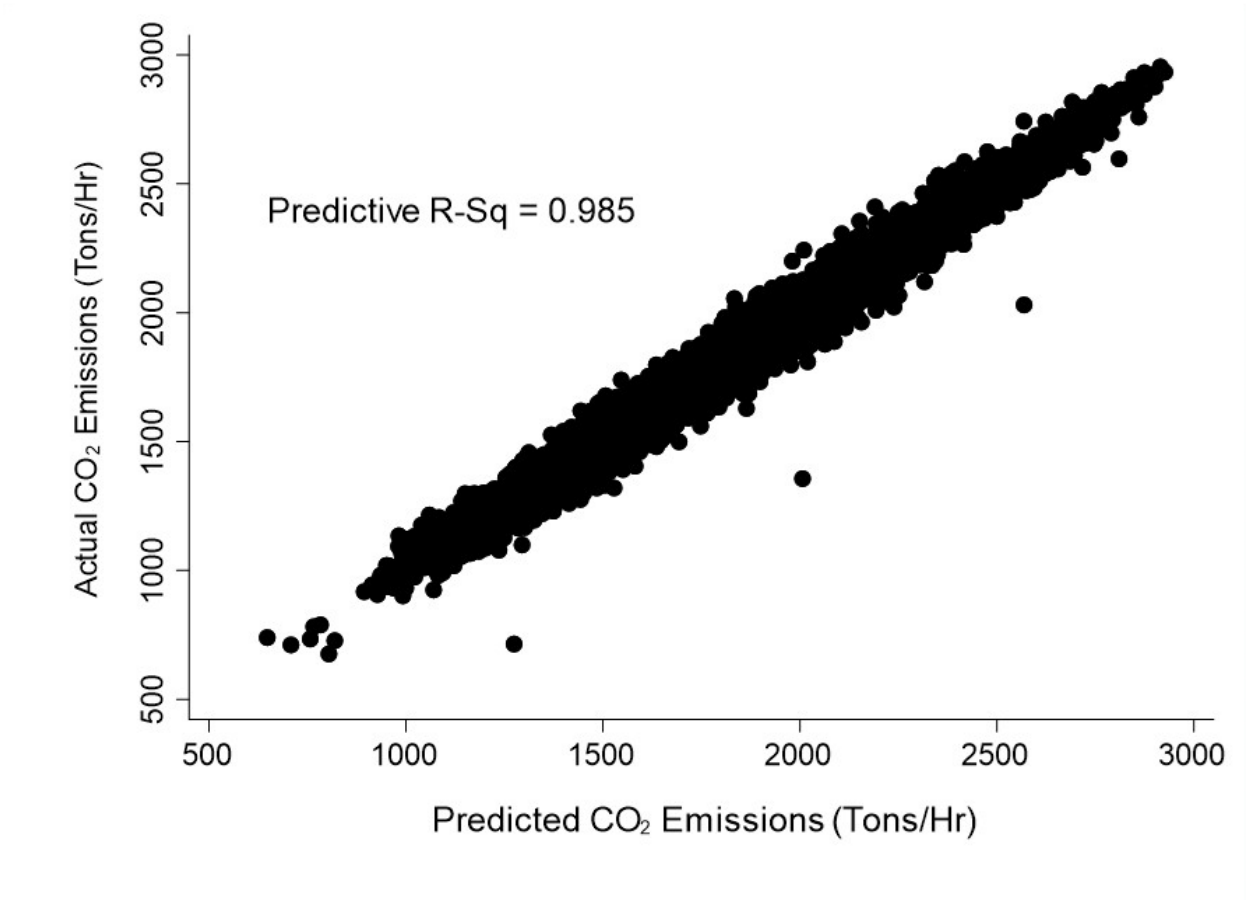

Figure 1. The model's out-of-sample predictive accuracy, 1 Jan 2017 through 31 December 2017

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