Quantifying the role of interest rates, the Dollar and Covid in oil prices

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Summary  
Focus  
Which are the key determinants of oil prices, and what role do financial factors play in Brent price formation? This paper sheds a new light on these fundamental questions relying on a widely used machine learning technique (random forests, based on 1,000 regression trees). As the article shows, the use of this technique leads to very large gains in oil price forecasting performance.  
Contribution  
Besides strong forecasting performance, this powerful data-driven method also uncovers how economic and financial variables relate to oil prices. The benchmark model relies on 11 explanatory variables, which are firmly grounded on economic theory and measured on a daily frequency. The analysis reveals that financial factors play a very significant role in Brent oil price formation, underscoring that oil prices are ultimately an asset price.  
Findings  
The analysis attests the strong performance of the random forest model in predicting oil prices. This is likely due to its ability to capture non-linearities, as well as complex interactions between explanatory variables. The out-of-sample root mean square errors (RMSEs) of the random forest model are between 51% and 68% lower than those of standard OLS models that use exactly the same set of explanatory variables. US interest rates, the value of the US dollar and the CBOE VIX market volatility index together account for 39% of the models' RMSE reduction, highlighting the importance of incorporating financial variables in an oil pricing model. The clear inverse relation between Brent price and the value of the US dollar is also made evident.  
  
Abstract  
This study analyses oil price movements through the lens of an agnostic random forest model, which is based on 1,000 regression trees. It shows that this highly disciplined, yet flexible computational model reduces in-sample root mean square errors (RMSEs) by 65% relative to a standard linear least square model that uses the same set of 11 explanatory factors. In forecasting exercises the RMSE reduction ranges between 51% and 68%, highlighting the relevance of non-linearities in oil markets. The results underscore the importance of incorporating financial factors into oil models: US interest rates, the dollar and the VIX together account for 39% of the models' RMSE reduction in the post-2010 sample, rising to 48% in the post-2020 sample. If Covid-19 is also considered as a risk factor, these shares become even larger.  
JEL classification: C40, F30, Q40, Q41, Q47.  
Keywords: dollar, forecasting, machine learning, oil, risk.