

Author: James Hamski
Email: james.hamski@spsmail.cuny.edu
Date: 2/27/2017

Investigating Oil Price Volatility

Motivation and Problem Introduction

I spent the first seven years of my career in the energy industry, first in electric power and then in oil and gas exploration. Therefore, it is my goal to apply my education in data science to this industry. I reached out to Reuters energy analyst [John Kemp](#) soliciting inspiration for data-focused questions he might like tackled by a data scientist. I was excited to have him respond back with a list of ideas and include several other analysts at the U.S. Energy Information Administration in the email, it is amazing how folks will help you out when you're offering to do free work.

Of the questions, three seem grouped around the general question of oil price volatility (i.e. variance of a financial product):

- 1) Does oil market volatility scale in percentages or dollars per barrel? If oil goes from \$50 to \$100, do average daily price changes adjust to the higher absolute price level?
- 2) Do weekly EIA oil and gas reports impact oil prices? These reports
- 3) Do Organization of the Petroleum Exporting Countries (OPEC) announcements impact oil prices?

These questions may be neatly approached in a paper which characterizes oil price volatility and the impact of information release events.

Literature Review

A subset of existing literature on oil price volatility was reviewed prior to this proposal. A comprehensive review will continue through the first phase of the project. Oil price volatility has primarily been studied with the goal of understanding the effects of shocks (i.e. large oil price movements) on inflation and economic performance indicators. Oil price forecasting has also been extensively studied. For questions (2) and (3) above, I intend to follow conclusions from this existing literature to look at these specific information releases.

For question (1), volatility clustering has been studied in oil prices, however I cannot find a specific answer to the question posed as: does oil market volatility scale with increasing price? This indicates the question may be a unique question to study.

Aloui, R., Gupta, R., & Miller, S. M. (2016). Uncertainty and crude oil returns. *Energy Economics*, 55, 92–100. doi:10.1016/j.eneco.2016.01.012

Behmiri, N.B., Manso, J.R. (2013). Crude oil price forecasting techniques: a comprehensive review of literature. *SSRN Electronic Journal*. DOI: 10.2139/ssrn.2275428.

Narayan, P. K., & Narayan, S. (2007). Modelling oil price volatility. *Energy Policy*, 35(12), 6549–6553. doi:10.1016/j.enpol.2007.07.020

Salisu, A. A. (2014). Modelling oil price volatility before, during and after the global financial crisis. *OPEC Energy Review*, 38(4), 469–495. doi:10.1111/opec.12037

Problem Formulation and Objectives

(1) poses a question about the relationship between price level and volatility. Narayan and Narayan, 2013 explored the effect of price shocks on oil price volatility, and I intend to borrow from their methodology and extend it to include price level. Preliminary exploration: by plotting oil price residuals from a 5-day moving average model against the price level in that model indicate that there is not a relationship between price level and volatility. It is my objective to present a robust exploration of this conclusion.

For questions (2) and (3) I will follow the work from Aloui, et al 2016 which looked at news-based uncertainty indices and their effects on oil price. However, my objective will be to study two specific sources: weekly EIA oil and gas reports and OPEC announcements. This approach may utilize ticker (minute-by-minute) price data instead of daily price data. My objective will be to determine if these reports affect the market, and if so by how much.

Technology Stack, Tools, and Methodology

It is my plan to rely on the R programming language for this project. The paper will be developed in the RStudio IDE utilizing a R Markdown notebook and GitHub (<http://github.com/jhamski>) for version control. Depending on data confidentiality, this repository may need to be private. While the core portion of my project is the paper exploring oil price volatility, I view the comprehensive project as an opportunity to show off further skills learned during my MSDA education, therefore if time allows it I plan to develop an accompanying Shiny application that allows a user to interact with visualizations for the project data.

I intend to rely heavily on time series analysis techniques. In preparation, I have been working through *Time Series Analysis with Application in R* by Cryer and Chan to ensure an appropriate level of fundamental knowledge in Box-Jenkins methodologies. In particular, I expect to utilize autoregressive integrated moving average (ARIMA) and generalized autoregressive conditional heteroskedastic models (GARCH) models.