**Financialization and the Impact of Exogenous Uncertainty on Crude Oil Futures**

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**Background**

The sharp oil price rise from 2003 to 2008 has often been attributed by academics and policy makers to the role of speculation[[1]](#footnote-1) driven by institutional investors’ gradual acceptance of oil derivatives in a process known as financialization (Masters, 2008; Brown and Sarkozy, 2009; Tang and Xiong, 2012; Hamilton and Wu, 2015). However, debate has arisen about the strength of speculation’s impact, with many academics questioning whether financialization or fundamentals was the main driver over that period (Buyuksahin and Harris 2011; Fattouh, Kilian, and Mahadeva, 2013). Although it is hard to pin down the exact effects of financialization, literature suggests that commodities have turned from an asset class for investors to diversify from the equity market (Gorton and Rouwenhorst, 2006) to being increasingly correlated with the equity market (Buyuksahin and Robe, 2014). Given the reliance of the global energy market on petroleum products, the changing price behaviour of crude oil has significant implications across society from policy makers to businesses. The financialization of the oil market may also be of interest to academics studying the dynamic of risk or pricing mechanisms, since commodities is one of the few assets classes that financialized in the 21st century.

Strong evidence of time-varying commodity futures risk premium attributed to financialization has emerged recently in the literature (Baumeister and Kilian, 2016), which includes a gradual increase in equity risk premium (Cheng, Kirilenko & Xiong 2013; Boons, de Roon and Szymanowska, 2014; Isleimeyyeh, 2019). While Cheng, Kirilenko & Xiong (2013) has used the VIX index to approximate traders’ risk appetite for agricultural commodities, I believe no direct analysis between equity risk and the oil market has been conducted. My proposed research will give evidence on the effect of (perceived) equity risk given by the VIX on WTI futures, as well as changes over time. With this I hope to extend existing literature on financialization from a novel perspective that takes the risk premium literature into account while directly inferring the time-varying impact of equity risk on crude returns.

**Research Questions**

1. What is the impact of shocks in the VIX on WTI futures returns?
2. How does that impact change over time as the oil market experiences financialization?
3. Does this effect extend to other forms of uncertainty such as geopolitical risk and economic policy uncertainty?

**Purpose & Aims**

1. Find whether there is an increased link between equity market uncertainty (volatility) and crude oil returns as equity risk premium literature suggests
2. Apply the Kalman filter algorithm to give a clearer picture on the time-varying nature of equity risk than current panel regressions
3. Explore the application of the methodology to other measures of risk such as geopolitical risk and economic policy uncertainty

**Significance**

My proposed research will be significant in giving evidence to either support or question the claim that equity risk premium has increased in oil futures, most recently advanced by Isleimeyyeh (2019). Risk premium measures the excess return demanded by the market for exposure to a certain variable, and current literature has been focused on the changing coefficient (beta) of equity returns in a linear equation describing crude returns. My research will directly test the link between volatility in the equity market and crude returns using an impulse response regression between crude returns and shocks in the VIX.[[2]](#footnote-2) Since the VIX is technically the expectation of 30-day S&P 500 volatility derived from the options market (CBOE, 2021), it is also a measure of equity market uncertainty (expected volatility) formed by options traders, and I will see if my methodology can be extended to other forms of perceived uncertainty as well such as geopolitical risk and economic policy uncertainty – though there might be endogenous variables at play for these latter measures.

My research also hopes to give a clearer picture of the changing relationship between equity uncertainty and crude returns by using the Kalman filter to estimate time-varying responses at a granular level. The use of the Kalman filter in constructing time-varying estimates of risk has already been established in general risk premia literature (Faff, Hillier and Hillier, 2003; Renzi-Ricci, 2016), though I have not come across any applications to estimating impulse response. I believe that the Kalman filter will be an improvement on naïve techniques such as panel regression in documenting the time-varying nature of responses, demonstrated by Renzi-Ricci (2016).

**Literature Review**

1. Overview of speculation and financialization
2. Risk premia in the commodity market, in particular equity risk premium
3. Construction of the VIX – difference between perceived and realized volatility
4. Alternative indices for macro uncertainty (EPU, GPR)

**Methodology**

For my independent variable I will limit the uncertainty indices used to mainly the VIX, though will also explore EPU and GPR indices. I intend to include the VIX3M and actual realised S&P 500 volatility as part of my robustness check.

For my dependent variable I will use WTI futures of maturity 1M. Spot and 3M futures will be used for robustness checks.

When starting my research, I will first consider the merits of DL, ARDL and VAR impulse response functions discussed by Kilian (2008). I intend to use the DL model due to difficulties in building an auto-regressive Kalman filter algorithm. However, a comparison will be made between the ARDL and DL specifications before moving onto time-varying estimation.

Finally, I will need to implement a Kalman filter algorithm to estimate the impulse response at each month to visualize changes over time. State space assumptions and shortcomings of the Kalman filter explored in Faff, Hillier and Hillier (2003) will be discussed.

**Timeline**

Not sure how much I need to get done by week 10, but should have a skeleton literature review ready. Data collection and exploratory analysis is complete.

**Expected Outcomes**

I expect a negative relationship between equity uncertainty and crude returns overall. Having done a naïve exploratory analysis, I also expect a strengthening of this negative relationship over time.

**References**

Baumeister, C., & Kilian, L. (2015). General Approach to Recovering Market Expectations from Futures Prices With an Application to Crude oil. *Working Paper*.

Boons, M., de Roon, F., & Szymanowska, M. (2014). The Price of Commodity Risk in Stock and Futures Markets. *Working Paper*.

Brown G, Sarkozy N. (2009). Oil prices need government supervision. *The Wall Street J.*, July 8. Available online: http://online.wsj.com/article/SB124701217125708963.html [Last accessed: February 2022].

Buyuksahin, B., & Harris, J. H. (2011). Do Speculators Drive Crude Oil Futures Prices. *The Energy Journal*, 32(2), 167–202.

Buyuksahin, B., & Robe, M. A. (2014b). Speculators, commodities and cross-market linkages. *Journal of International Money and Finance*, 42, 38–70.

CBOE. (2021). VIX Whitepaper. *CBOE Website*. Available online: https://cdn.cboe.com/resources/vix/vixwhite.pdf [Last accessed: February 2022].

Cheng, I.-H., Kirilenko, A., & Xiong, W. (2015). Convective Risk Flows in Commodity Futures Markets. *Review of Finance*, 19 (5), 1733–1781.

Faff, R. F., Hillier D., & Hillier, J. (2003). Time Varying Beta Risk: An Analysis of Alternative Modelling Techniques. *Journal of Business Finance & Accounting*, 27(5-6), 523-554.

Fattouh, B., Kilian, L., & Mahadeva, L. (2013). The Role of Speculation in Oil Markets: What Have We Learned So Far? *The Energy Journal*, 34(3), 7–33.

Gorton, G., & Rouwenhorst, K. G. (2006). Facts and fantasies about commodity futures. *Financial Analysts Journal*, 62(2), 47–68.

Hamilton, J. D., & Wu, J. C. (2015). Effects of Index-Fund Investing on Commodity Futures Prices. *International Economic Review*, 56(1), 187–205.

Isleimeyyeh, M. (2019). [Forthcoming] The Role of Financial Investors in Determining the Commodity Futures Risk Premium. *Journal of Futures Markets*.

Kilian, L. (2008). A Comparison of the Effects of Exogenous Oil Supply Shocks on Output and Inflation in the G7 Countries. *Journal of the European Economic Association*, 6(1), 78-121.

Masters M. (2008). Testimony before the Committee on Homeland Security and Governmental Affairs. Tech. Rep., US Senate, Washington, DC, May 20th

Renzi-Ricci, G. (2016). Estimating Equity Betas: What Can a Time-Varying Approach Add? *NERA Economic Consulting Website*. Available online: https://www.nera.com/content/dam/nera/publications/2016/PUB\_Estimating\_Equity\_Betas\_0916.pdf#:~:text=The%20Kalman%20filter%20is%20a%20recursive%20algorithm%2C%20i.e.%2C,that%20OLS%20techniques%20have%20in%20measuring%20time-varying%20betas. [Last accessed: February 2022].

Tang K, Xiong W. (2012). Index investment and financialization of commodities. *Financial Analysts Journal* 68(6), 54–74.

1. Although no satisfactory definition for speculation (especially its separation from hedging) exists, it is broadly defined as the purchasing of commodities for anything other than immediate use (Fattouh, Kilian and Mahadeva, 2013) [↑](#footnote-ref-1)
2. Shocks defined as the difference between percentage change of VIX and percentage change of 12-month rolling average of the VIX [↑](#footnote-ref-2)