**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). 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.

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). 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). 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 crude futures 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 expected uncertainty in the stock market 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 function 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 impulse responses at a granular level. Kalman filtering 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 current techniques such as panel regression, 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. I intend to use spot and 3M futures for robustness checks, as well as the broader Goldman Sachs Commodity Index.

My sample timeframe will span 3 decades from 1990 to 2021, which corresponds to the data available on the VIX.

When starting my discussion on methodology, I will first consider the merits of distributed lag (DL), auto-regressive distributed lag (ARDL) and vector auto-regressive (VAR) impulse response functions discussed by Kilian (2008). Since we are working under the assumption of exogenous shocks, a VAR approach will impose unnecessary complexity when moving to state-space form for time-variance and requires identifying assumptions on underlying structure (Kilian, 2008). I will instead focus on the linear models for this study, adapting Kilian (2008) to allow for contemporaneous feedback as used for shocks in expectation in Kilian & Hicks (2013). A general comparison will be made between the ARDL and DL specifications before moving onto time-varying estimation.

Starting my analysis into time-variance, I will first split the data into decade-long panels and get an idea of the general trend. Then, I will implement the 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 also 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**

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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)