EVIDENCE ON THE FINANCIALIZATION OF OIL PRICE RISK

Atle Oglend, University of Stavanger, Department of Industrial Economics and Risk Management, NO-4036,Stavanger, Norway, +47 51832247, atle.oglend@uis.no

Petter Osmundsen, University of Stavanger, Department of Industrial Economics and Risk Management, NO-4036, Stavanger, Norway, +47 51831568, petter.osmundsens@uis.no

Overview

Since the financial crisis there has been focus on 'financialization' of commodity markets and associated commodity related markets (Tang and Xiong, 2010; Silvennoinen and Thorp, 2013; Cheng and Xiong, 2013). Financialization of markets refers to the claimed increased influence of financial markets, or risk factors, on commodity markets, including commodity spot and futures pricing. For oil, it relates to the question of whether oil price risk, the source of oil price uncertainty, is increasingly correlated with financial asset price risk, and the participation of financial agents, i.e. investment banks, in oil markets (Fattouh et al., 2013). Research indicates that the connection between commodities and equities has strengthened since the financial crisis in 2008 (Berger and Uddin, 2016; Delatte and Lopez, 2013).

This paper analyzes the financialization of short run oil price risk. Using near term WTI futures contract prices and the WTI spot price, we derive a measure of the daily risk-neutral oil price risk, i.e. the risk neutral spot price forecasting error. We proceed to test the changing influence of equity price risk on this measure of short run oil price risk. This is achieved using a Bai and Perron (1998) structural change test on a linear factor pricing model, subject to a set of control variables. We also test the predictive power of equity returns on oil price returns, as well as the Granger causality between futures market interest and oil price changes. Consistent with previous research, we document an increasing association between equity and oil price risk after the financial crisis in 2008.

Methods

We derive the risk neutral distribution of daily oil pricing errors. This is done using a simple risk-neutral pricing model. With spot WTI oil price S_t and nearest term futures contract price $F_{t|t+n}$, the risk-neutral day-ahead price forecast of oil is,

$$\bar{S}_{t+1} = S_t \left(\frac{F_{tt+n}}{S_t}\right)^{\frac{1}{n}} \quad (1)$$

If risk neutral pricing follows the multiplicative cost-of-carry model: $E_t S_{t+n} = F_{t|t+n} = S_t {c_t}^n$, where c_t is a known daily cost-of-carry and $E_t S_{t+n}$ the risk-neutral expectation of the future spot price, then (1) will produce the correct risk neutral forecast, i.e. $\bar{S}_{t+1} = E_t S_{t+1}$. We proceed by defining the risk-neutral (percentage) pricing error, $u_{t+1}^{RN} = \frac{S_{t+1}}{\bar{S}_{t+1}} - 1$. This defines daily oil price risk according to the NYMEX WTI futures contract price. Specifically, u_{t+1}^{RN} is a martingale difference sequence under the risk neutral measure. We consider the following linear pricing model for the short run price risk,

$$u_t^{RN} = \lambda_0 + \beta r_{m,t} + \boldsymbol{X}_t \lambda_{\boldsymbol{1}} \quad (2)$$

where λ_0 is an unconditional daily risk-premium, and $\boldsymbol{X}_t$is a vector of control variables. Our primary interest is β, the loading on the financial asset, or equity, price risk, $r_{m,t}$, which we measure by the return on the S&P500 asset price index. Equity risk implies $\beta \neq 0$.

To robustly test $\beta \neq 0$ we apply a set of control variables from the literature on commodity pricing. This includes 1) interest rate risk (the change in the 3-month US T-bill); 2) hedging pressure (the change in net commercial long positions on NYMES Crude contracts divided by contract open interest; 3) implied volatility of WTI futures derived from options on WTI futures; 4) volatility risk premium (calculated as implied volatility less realized volatility); and 5) physical oil stock variations (change in US inventories of crude oil excl. strategic reserves).

We apply the Bai and Perron (1998) structural change test whether pricing equation (1) has changed over time. We also test the predictive power of $r_{m,t}$ on future price shocks. Given the research focus on the influence of speculation on commodity pricing, we also test the predictive power of hedging pressure and futures market open interest on short run oil price as well as the reverse hypothesis.

Results

The data used is daily WTI spot prices, the nearest term daily NYMEX WTI futures prices, daily 3-month US treasury bill (I.R), weekly commercial net-long positions in WTI futures (H.P., from Commodity Research Bureau commitments of traders data), daily WTI futures implied volatility (I.V., from the Commodity Research Bureau), daily volatility risk premium measure (V.P., implied volatility less historical realized volatility), and physical stock variation (P.S., changes in US stocks of crude oil excluding strategic reserves, EIA data). Given the commitments of traders data is weekly, we consider the prediction of the weekly average daily oil price change. That is, u_t^{RN} in (1) is the weekly average of daily changes.

TABLE 1. Estimating the Financial market loading (β) on short run oil price risk

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Controls:												
I.R.	-		x		x		x		x		x	
H.P.	-		-		x		x		x		x	
I.V.	-		-		-		x		x		x	
V.P.	-		-		-		-		x		x	
P.S.	-		-		-		-		-		x	
Regime	*Est.*		*Est.*		*Est.*		*Est.*		*Est.*		*Est.*	
Regime1	*? - 2008(35)*		*? - 2008(35)*		*? - 2008(35)*		*? - 2008(52)*		*? - 2008(52)*		*? - 2008(52)*	
Regime2	*2008(35) - ?*		*2008(35) - ?*		*2008(35) - ?*		*2008(53) - ?*		*2008(53) - ?*		*2008(53) - ?*	
β	*Est.*	R^2	*Est.*	R^2	*Est.*	R^2	*Est.*	R^2	*Est.*	R^2	*Est.*	R^2
Regime1	*-0.11*	*~0.0*	*-0.11*	*~0.0*	*-0.10*	*0.017*	*0.145*	*0.044*	*0.14*	*0.042*	*0.14*	*0.041*
Regime2	0.95*	0.18	0.94*	0.18	0.934*	0.177	0.87*	0.188	0.86*	0.188	0.86*	0.186

Note: * significance at 1% level. I.R. – interest rate, H.P. – hedging pressure, I.V. – implied volatility, V.P. – volatility premium, P.S. – Physical stocks.

Table 1 shows the structural change rest results under various control variable models. All models consistently find one structural change in (1) in the latter half of 2008. The first regime (prior to 2008) cannot reject the null of no association between equity and oil price risk, $\beta = 0$. The second regime (post 2008) strongly rejects $\beta = 0$ under all controls. There is evidence of increased financialization of short run oil price risk post 2008. Since 2008, around 18% of the unexpected variation in the weekly average oil price is accounted for by the change in financial asset prices.

In a predictive test, we fid that positive (negative) oil price shocks increase (decrease) the demand for commercial short hedging in oil futures. In addition, positive (negative) price shocks increase (decrease) futures open interests. There is no evidence of reverse causality. Consistent with table 1, lagged equity returns have predictive power on changes on short run oil price changes after the financial crisis.

Conclusions

Shor-run oil price risk has gone from depending on oil specific factors such as hedging pressure and expected oil market uncertainty, to correlating with equity market risk factors. In our model with multiple controls, equity risk remains by far the most important risk factor in short run oil risk after the financial crisis in 2008, consistent with increased financialization. However, we do not find that variables related to interest in futures market trading (open interest and hedging pressure) determine oil price changes, rather we find that causality is more likely to run from oil price shocks to interest in trading and futures market positioning.

References

Bai, J., and P. Perron. 1998. "Estimating and testing linear models with multiple structural changes." *Econometrica*:47-78.

Berger, T., and G.S. Uddin. 2016. "On the dynamic dependence between equity markets, commodity futures aneconomic uncertainty indexes." *Energy Economics* no. 56:374-383.

Cheng, I.-H., and W. Xiong. 2013. "The financialization of commodity markets."

Delatte, A.-L., and C. Lopez. 2013. "Commodity and equity markets: Some stylized facts from a copula approach." *Journal of Banking & Finance* no. 37 (12):5346-5356.

Fattouh, B., L. Kilian, and L. Mahadeva. 2013. "The Role of Speculation in Oil Markets: What Have We Learned So Far?" *The Energy Journal* no. 34 (3):7.

Silvennoinen, A., and S. Thorp. 2013. "Financialization, crisis and commodity correlation dynamics." *Journal of International Financial Markets, Institutions and Money* no. 24:42-65.

Tang, K., and W. Xiong. 2010. "Index investment and financialization of commodities."