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Volatility of commodity futures prices and market-implied inflation expectations

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ABSTRACT

This study examines intricate interplay between crude oil, copper and gold futures prices, and market-implied inflation expectations that are proxied by the breakeven inflation derived from the 5-year US Treasury Note yields. We perform the Bai-Perron multiple breakpoint tests, Bayesian VAR with impulse response functions and GARCH with GED parameterization tests on daily data for the sample period January 3, 2003 – March 26, 2015. The results show a strong causal impact of shocks in the breakeven inflation on West Texas Intermediate and Brent crude oil as well as copper futures prices, albeit to varied degrees during the examined sample period. At times of low market risk and highly liquid markets West Texas Intermediate and copper futures prices move in tandem with the 5-year breakeven inflation. Prices of Brent and gold futures move in the opposite direction to the market-implied inflation.

1. Introduction

We aim to investigate the interplay between changes in selected commodity futures prices and market-implied inflation expectations proxied by the breakeven inflation (BEI). We apply the 5-year BEI rate, which represents a measure of expected inflation derived from 5-year Treasury Constant Maturity Securities and 5-year Treasury Inflation-Protected Constant Maturity Securities (TIPS). In essence, the 5-year BEI indicates the expected inflation over the next 5-year period by bond market participants.

We subscribe to the general notion that the market-implied inflation expectations have a pronounced impact on commodity futures prices, albeit to varied degrees and directions depending on the specific commodity and market risk conditions. We do not presume a reverse causality, i.e. an impact of changes in commodity futures prices on the market-implied inflation expectations.

There is an extensive body of literature examining the relationship between commodity prices and financial variables, mainly exchange rates, interest rates and equity prices. Among others, Blanchard and Gali (2007) discuss significant differences in reactions of oil prices to the macroeconomic fundamentals between the 1970 s and 2000 s. Lizardo and Mollick (2010) show that crude oil prices significantly and continuously explain changes in the US dollar (USD) exchange rate. Reboredo (2012), Ding and Vo (2012) and Fratzscher et al. (2014) argue that such causal impact becomes stronger at times of financial crises. Sari et al. (2010) provide evidence of pronounced short-run responses of metal futures prices and weaker reactions of oil prices to the USD exchange rate. Balcilar et al. (2017) focus on asynchronous co-movements between shocks

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in S&P 500 equity prices and West Texas Intermediate (WTI) oil prices, arguing that stocks are driven mainly by permanent shocks, while oil prices are subject to both permanent and temporary disturbances. Investigating patterns of signal diffusion among different financial markets, Narayan et al. (2017) provide evidence of cross-market pricing transmission from gold, to bonds, to oil and subsequently to inflation, based on long-term (1950–2015) monthly data. Examining similar market reactions during the post-financial crisis period Batten et al. (2017) show that equity prices have moved in tandem with oil prices, particularly in Asian markets.

Nevertheless, the interplay between futures prices and inflation expectations has been addressed rather sparsely. Most of the empirical literature on this subject is based on lower frequency, monthly data and inflation expectations based on headline or core inflation measures. The novel aspect of our approach is the application of high frequency daily financial data (one-month futures settlement prices) and the BEI-based inflation expectations measure. We have chosen two energy and two metal futures that are most frequently addressed in the empirical literature and market reports as being presumably tied to key financial variables including inflation expectations. Our four selected commodity futures include Brent and WTI crude oil, copper and gold. Our daily database includes 3074 observations for futures prices and the 5-year BEI during the January 3, 2003 – March 26, 2015 sample period. The starting point of our sample period coincides with the earliest availability of data for the 5-year BEI. We have also tested the longer-term, 10-year BEI and decided not to use it in our paper, as its rather smooth trajectory over the long-range expectations horizon weakens the connection with daily changes in commodity futures prices. Moreover, long-term inflation expectations embedded in the 10-year BEI are mainly affected by central banks' credibility and overall ability to control inflation, while medium-term expectations reflected by the 5-year BEI carry information about market news and forecasts (Gürkaynak et al., 2010; Cunningham et al., 2010; Strohsal and Winckelmann, 2015).

In addition to testing time responses, we examine the varied degrees of responses of individual futures prices to BEI. We perform the stationary ordinary least-squares (OLS) regression, subsequently augmented with the Bai-Perron multiple breakpoint (MBP) tests that enable us to analyze the intricate interplay of our variables at different sub-periods and varied financial stability conditions. We also conduct the conditional volatility testing of these relationships by employing the generalized autoregressive conditional heteroscedasticity GARCH(p,q) tests with the general error distribution (GED) parameterization, which allows us to estimate the degree of leptokurtosis (i.e. tail risks) in the conditional volatility series.

Based on the prior available empirical research and market reports that we review in the literature section of our paper, we initially assume that inflation expectations have a pronounced positive impact on crude oil and copper futures prices, and a weaker positive impact on gold prices. We further assume that the causal reactions between the breakeven inflation and futures prices are seemingly different at normal (tranquil) versus turbulent market periods. We hypothesize that at times of financial distress the interactions between inflation expectations and commodity futures become weakened, somewhat suppressed by higher market risk.

Section 2 provides a brief survey of pertinent literature. In Section 3, we identify and discuss the specific variables and describe our database. We believe that prior to devising an appropriate model and performing its empirical testing, we ought to analyze causal reactions and impulse responses between shocks in commodity futures prices and shocks in BEI. These mutual responses are shown and analyzed in Section 4. Our baseline analytical model is presented and tested with a stationary OLS in Section 5. Subsequently, in Section 6 we conduct a MBP regression to detect structural breaks from data. In Section 7 we perform the GARCH conditional volatility analysis. Section 8 summarizes our key findings.

2. Literature overview

The literature examining the relationship between commodity futures prices and various economic and financial variables is quite extensive. However, most of these studies address linkages between gold and oil futures prices on the one side, and interest rates and exchange rates on the other. The association of futures prices with market-implied inflation expectations is sparsely analyzed. In particular, only the most recent studies consider market-implied inflation expectations based on break-even inflation measure that is derived on the basis of Treasury Inflation-Protected Securities (TIPS) first introduced by the US Treasury only in 1997. The consistent BEI data have become available as of 2003.

The early dominant view was that BEI-based inflation expectations measure was less accurate in predicting inflation than inflation expectations derived more directly from real and nominal yield curves, particularly at turbulent market periods as argued by Adrian and Wu (2009). They attributed this inaccuracy to the markets for TIPS being considerably less liquid than those for nominal on-the-run Treasuries. However, as argued by Söderlind (2011), BEI is gaining traction among monetary policy-makers and security investors as an accurate predictor of expected inflation. It is because changes in BEI are not only caused by the expected inflation but can also be affected by shifts in inflation risk and liquidity risk premium.

Several studies point out to a discernible impact of oil shocks on short- and long-term inflation expectations embedded in yields of U.S. Treasury securities. Among others, Celasun et al. (2012) suggest that "oil price shocks have a statistically significant, albeit economically small impact on longer-term inflation expectations". They further argue that this relationship has become stronger in the aftermath of the 2008 financial crisis – the intensity of which they attribute to heightened inflation uncertainty and to the expansionary monetary policy. A stronger correlation between changes in futures prices and inflation expectations at times of financial distress is also shown by Lumsdaine (2009). This co-movement is particularly discernible for shorter-term inflation expectations as measured by shorter maturity BEI. As argued by

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