US economic policy uncertainty spillovers to commodity returns: fresh evidence through Granger causality in quantiles

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ABSTRACT

Given the importance of U.S. in global commodity markets, the goal is to explore whether US economic policy uncertainty impacts the price performance of certain commodities. The analysis uses the Granger causality in quantiles method that allows us to test whether there are different effects under different market conditions. The results document that economic uncertainty impacts the returns on the commodities considered, with the effects clustering around the tail of their conditional distribution. Robust evidence was obtained under an alternative definition of uncertainty.

*Keywords*: US economic policy uncertainty; commodities; Granger causality; quantiles

*JEL codes*: G18; G11

**1. Introduction**

Investment commodities have been a substantial part of investors’ portfolio, thus, improving the role of drivers of their prices is a significant research objective. The literature has emphasized both supply-side and demand side factors in determining their prices (Kilian, 2009; Kim and Vera, 2018; among others). There has been a specific strand in the literature (mostly for oil and gold) that provide solid evidence that these commodities are significantly influenced by certain non-fundamentals, such as Economic Policy Uncertainty (EPU) and investors’ attention (Aloui et al., 2016; Wang and Sun, 2017; Uddin et al., 2018). The findings document that these prices are positively associated with EPU. Aloui et al. (2016) use a copula approach and find that higher economic uncertainty significantly increases oil returns and only during certain periods, while Uddin et al. (2018) use an entropy-type of wavelet approach and reach similar results. Finally, Li and Lucey (2017) document that economic policy uncertainty positively affects gold returns, with Raza et al. (2018) providing similar findings. In terms of causality, Kang and Ratti (2013) and Balcilar et al. (2017) find the presence of causality is running from US EPU to oil and gold returns.

The goal of the paper is to use a parametric Granger causality test in quantiles, proposed by Troster (2018), to study for the first time whether the US EPU index can predict the returns of certain commodities. The novelties of the paper are related to the fact that instead of focusing on specific episodes of market periods for the examination of the predictive effect of US EPU on commodity returns, the analysis employs a parametric quantile causality approach. This method is capable of considering all market conditions jointly (i.e., bearish, bullish), which allows us to explore under what conditions the US EPU could predict commodity returns. In addition, the recommended method has two novel characteristics: first, it takes into consideration different locations and scales of the conditional distribution, which provides richer information on causality than the traditional mean causality approach. Moreover, it can address the problem of structural breaks and sample segmentation, given that many studies have illustrated that oil and gold prices have nonlinear and structural mutation characteristics (Chen et al., 2014; Gil-Alana et al., 2015). However, segmentation tends to lose important sample information (Pershin et al., 2016). The findings clearly indicate that while there is no evidence supporting a causal link between the US EPU and commodity returns at the median of the conditional distribution, this link clusters around the tails of this distribution. US EPU has a strong predictive power on the majority of commodity returns when the markets are in a bearish state (with the exception of the precious metal markets); in the bullish state, this link disappears. In the case of the precious metal markets, the findings document that only when these markets are in a bullish state, causality running from US EPU to commodity returns does exist.

**2. Data**

The empirical analysis considers monthly price data from certain commodity markets (i.e., oil, natural gas, gold, silver, platinum, copper, nickel, and aluminium). Related price series start in January 1990 and end at December 2018. All commodity prices are transformed into first-logarithmic differences (i.e., returns). In terms of economic policy uncertainty, the analysis uses the US economic policy uncertainty index recommended by Baker et al. (2016) and which is constructed as a weighting average including three components, capturing the news associated with policy-related uncertainty, the number of federal tax code provisions set to expire in the future, and disagreement among economic forecasters. Table 1 provides certain summary statistics.

**[Insert Table 1 about here]**

**3. Empirical analysis**

This part analyzes the importance of the US economic policy uncertainty index in predicting the returns of our commodities considering the quantiles conditional distribution through the method recommended by Troster (2018). Details on this particular causality method can be found in the online Appendix. This non-linearity method has been shown and supported by Lacheheb and Sirag (2019), where they show that positive and negative oil price changes have different effects on inflation. In particular, their findings document the presence of a significant relation between oil price increases and the inflation rate, whereas, a significant relation between oil price reduction and inflation was absent. Table 2 reports the p-values for the test of the quantile-causality running from the economic policy uncertainty index to commodity returns. The table also reports the results from the entire distribution. The findings clearly indicate that in terms of the entire distribution, causality is detected only in the cases of oil and gold returns and at the 10% significance level, indicating that this uncertainty index does not have a strong ability in predicting the returns of an extended set of commodity returns. By contrast, when it comes down to quntiles, causality is strongly found in the tails of the distribution across all commodity returns.

In particular, the test results provide strong evidence that in the cases of oil, natural gas, copper, nickel and aluminium causality significantly exists in the lower quantiles, i.e. around 0.1, 0.2, 0.3 and 0.4 quantiles, while this is not the case in higher quantiles. This finding, however, is not valid for the cases of gold, silver and platinum. These results imply that the explanatory power of the economic policy uncertainty for commodity returns seems to be heterogeneous across different market conditions. For instance, when the markets are in a bearish state (commodity returns at the lower quantiles), policy uncertainty has a significant impact on returns; by contrast, under a bullish state (commodity returns at the higher quantiles), the impact is highly limited (insignificant). Thus, for this group of commodities such results document that economic uncertainty causes panic conditions in relevance to the uncertainty of future policy, leading to lower demand. These bear market conditions, in turn, imply low commodity prices (and returns) comparatively to bullish market conditions. These results are in conflict with those by Balcilar et al. (2017) for oil returns about the strong role of the US economic policy uncertainty and in terms of the entire distribution.

By contrast, in terms of gold, silver and platinum returns, the findings document that economic policy uncertainty has a major role to play only in the higher quantiles of their conditional distribution. In other words, policy uncertainty matters only when these two markets are in a bullish scenario. In that case, investors choose gold to avoid potential future risks and in order to secure high profits in the bull markets. These findings are in conflict with those provided by Jones and Sackley (2016) and Li and Lucey (2017) for gold returns.

**[Insert Table 2 about here]**

This part of the analysis repeats the estimation by replacing the US EPU index with the VIX index. This reflects implied volatility on the S&P500 index over a 30-day look-ahead period, with the data coming from Datastream. The VIX is built from a weighted average of European-style call and put options on the S&P500 that straddle the 30-day maturity and cover a wide range of strikes. The new results are reported in Table 3 and provide robust support to those in Table 2, albeit with lower algebraic estimates.

**[Insert Table 3 about here]**

Finally, this part considers a multivariate framework to re-estimate the causality modelling. In particular, for oil and natural gas commodities, the additional variables are those of global aggregate demand and the US dollar effective exchange rare (Kilian and Zhou, 2019). The proxy for the former comes from the OECD Monthly Economic Indicators (MEI) and it is aggregated industrial production across OECD countries (Ciccarelli and Mojon, 2010). For the precious metal commodities, the new framework considers the variables of global demand, a global inflation index obtained from Ciccarelli and Mojon (2010) and the stock market indexes of Dow Jones, FTSE100, Nikkei225 and DAX30. Finally, for the cases of copper, nickel and aluminium the additional drivers include the global demand index, the US effective dollar rate and their opposite competitive prices. All data come from Datastream. The new results (with the VIX index) are presented in Table 4. They clearly lend support to the previous findings, with the exception of copper, nickel and aluminum prices, where the results are statistically insignificant across all quantiles.

**[Insert Table 4 about here]**

**4. Conclusion**

The analysis highlighted the predictable effect of economic policy uncertainty with respect to certain commodity returns only at the tails of their conditional distribution. Gold, silver and platinum displayed different responses to policy uncertainty against the markets of oil, natural gas, copper, nickel and aluminium. While the majority of commodities reacted to bearish environments, the three precious metals reacted to bullish conditions. The results survived certain robustness tests in terms of an alternative definition of uncertainty and a multivariate framework. These findings infer significant implications for investors. More specifically, they imply that investors should be aware that there exists predictive power of policy uncertainty for commodity returns (and prices) observed during extreme market conditions (low and high commodity price periods). Moreover, they inspire precious metals investors that more prudent investment strategies are needed when their markets are in a bullish state.

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**Table 1**

Descriptive statistics.

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Variable Mean SD Min Max

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Oil 47.42 29.67 11.35 133.88

Natural gas 4.76 2.73 1.72 13.05

Gold 717.49 460.54 252.90 1896.50

Silver 11.41 8.50 3.95 35.12

Platinum 856.84 459.82 360.02 1,719.03

Copper 4,241.1 2,487.2 1,341.3 9,970.0

Nickel 13,306.8 8,137.7 4,009.5 50,575.0

Aluminium 1,760.6 439.3 1,025.8 3,106.3

EPU 107.3 71.9 10.1 626.0

VIX 19.27 7.81 9.14 80.86

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SD = standard deviation. EPU = economic policy uncertainty.

**Table 2**

Quantile causality results: (EPU and commodity returns).

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Commodity Lag Mean 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

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Oil 1 0.037\* 0.088\*\*\* 0.086\*\*\*  0.046\*\* 0.024 0.027 0.025 0.021 0.018 0.015

[0.08] [0.00] [0.00] [0.03] [0.18] [0.16] [0.19] [0.24] [0.29] [0.33]

Natural gas 1 0.019 0.094\*\*\* 0.091\*\*\*  0.063\*\*\* 0.029 0.028 0.022 0.020 0.019 0.011

[0.28] [0.00] [0.00] [0.01] [0.16] [0.16] [0.21] [0.23] [0.24] [0.32]

Gold 1 0.034\* 0.016 0.015 0.021 0.025 0.024 0.048\*\* 0.063\*\*\* 0.080\*\*\* 0.092\*\*\*

[0.10] [0.27] [0.28] [0.24] [0.21] [0.21] [0.03] [0.01] [0.00] [0.00]

Silver 2 0.012 0.013 0.011 0.019 0.022 0.024 0.042\*\* 0.056\*\* 0.072\*\*\* 0.088\*\*\*

[0.33] [0.32] [0.35] [0.30] [0.27] [0.25] [0.04] [0.02] [0.00] [0.00]

Platinum 1 0.009 0.012 0.014 0.018 0.024 0.025 0.053\*\* 0.070\*\*\* 0.088\*\*\* 0.102\*\*\*

[0.36] [0.33] [0.31] [0.28] [0.26] [0.25] [0.02] [0.00] [0.00] [0.00]

Copper 2 0.018 0.076\*\*\* 0.068\*\*\* 0.051\*\*\* 0.036\* 0.020 0.018 0.014 0.012 0.008

[0.25] [0.00] [0.00] [0.01] [0.08] [0.27] [0.29] [0.35] [0.37] [0.43]

Nickel 1 0.034\* 0.083\*\*\* 0.072\*\*\* 0.057\*\*\* 0.039\* 0.018 0.013 0.011 0.008 0.003

[0.09] [0.00] [0.00] [0.01] [0.07] [0.29] [0.34] [0.36] [0.40] [0.45]

Aluminum 1 0.025 0.081\*\*\* 0.070\*\*\* 0.061\*\*\* 0.042\*\* 0.020 0.016 0.010 0.005 0.001

[0.14] [0.00] [0.00] [0.00] [0.05] [0.27] [0.31] [0.37] [0.43] [0.48]

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Figures in brackets denote p-values. The estimation applied a sub-sampling method to calculate the p-values, where the subsample size is 11. The analysis implemented tests for Granger-causality in quantiles by testing the null over a grid of nine quantiles, where the null hypothesis of Granger non-causality holds if it is not rejected. \*: p≤0.10; \*\*: p≤0.05; \*\*\*: p≤0.01.

**Table 3**

Quantile causality results: (VIX and commodity returns).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Commodity Lag Mean 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

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Oil 1 0.032\* 0.073\*\*\* 0.064\*\*\* 0.040\*\* 0.019 0.022 0.021 0.014 0.015 0.011

[0.09] [0.00] [0.00] [0.04] [0.24] [0.20] [0.24] [0.31] [0.33] [0.39]

Natural gas 1 0.013 0.085\*\*\* 0.078\*\*\* 0.051\*\*  0.023 0.022 0.016 0.014 0.010 0.007

[0.35] [0.00] [0.00] [0.02] [0.20] [0.23] [0.29] [0.38] [0.42] [0.41]

Gold 2 0.025 0.012 0.010 0.012 0.021 0.025 0.042\*\* 0.059\*\*\* 0.073\*\*\* 0.082\*\*\*

[0.13] [0.33] [0.40] [0.37] [0.28] [0.24] [0.04] [0.01] [0.00] [0.00]

Silver 2 0.008 0.011 0.014 0.024 0.020 0.021 0.037\*\* 0.051\*\* 0.065\*\*\* 0.081\*\*\*

[0.40] [0.35] [0.33] [0.25] [0.29] [0.28] [0.04] [0.02] [0.01] [0.00]

Platinum 1 0.005 0.010 0.013 0.023 0.022 0.027 0.051\*\* 0.065\*\*\* 0.079\*\*\* 0.090\*\*\*

[0.44] [0.37] [0.33] [0.25] [0.28] [0.23] [0.02] [0.01] [0.00] [0.00]

Copper 1 0.014 0.072\*\*\* 0.060\*\*\* 0.045\*\* 0.032\* 0.014 0.012 0.010 0.008 0.004

[0.31] [0.00] [0.00] [0.02] [0.09] [0.36] [0.41] [0.48] [0.50] [0.59]

Nickel 1 0.030\* 0.077\*\*\* 0.064\*\*\* 0.051\*\* 0.032\* 0.012 0.009 0.007 0.003 0.000

[0.10] [0.00] [0.01] [0.02] [0.08] [0.35] [0.42] [0.47] [0.59] [0.67]

Aluminum 2 0.021 0.071\*\*\* 0.062\*\* 0.049\*\* 0.033\*\* 0.013 0.010 0.006 0.002 0.000

[0.20] [0.00] [0.02] [0.03] [0.05] [0.38] [0.41] [0.52] [0.59] [0.72]

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As in Table 2.

**Table 4**

Quantile causality results: (VIX and multivariate model).

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Commodity Lag Mean 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

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Oil 1 0.029\* 0.061\*\*\* 0.055\*\*\* 0.036\*\* 0.014 0.019 0.012 0.011 0.010 0.006

[0.10] [0.00] [0.00] [0.05] [0.28] [0.25] [0.31] [0.35] [0.39] [0.51]

Natural gas 1 0.010 0.074\*\*\* 0.067\*\*\* 0.043\*\*  0.020 0.015 0.010 0.009 0.004 0.002

[0.39] [0.00] [0.00] [0.03] [0.26] [0.31] [0.40] [0.47] [0.59] [0.68]

Gold 1 0.022 0.008 0.004 0.009 0.016 0.021 0.037\*\* 0.052\*\*\* 0.064\*\*\* 0.072\*\*\*

[0.14] [0.39] [0.46] [0.40] [0.34] [0.28] [0.05] [0.01] [0.00] [0.00]

Silver 1 0.004 0.006 0.010 0.019 0.015 0.018 0.031\*\* 0.045\*\* 0.057\*\*\* 0.070\*\*\*

[0.53] [0.39] [0.37] [0.28] [0.34] [0.33] [0.05] [0.03] [0.01] [0.00]

Platinum 1 0.003 0.006 0.010 0.017 0.018 0.021 0.043\*\* 0.053\*\*\* 0.070\*\*\* 0.078\*\*\*

[0.48] [0.41] [0.38] [0.30] [0.33] [0.27] [0.03] [0.01] [0.00] [0.00]

Copper 1 0.009 0.036 0.031 0.020 0.016 0.011 0.005 0.003 0.002 0.000

[0.36] [0.19] [0.26] [0.40] [0.49] [0.54] [0.60] [0.63] [0.69] [0.73]

Nickel 1 0.025 0.031 0.023 0.019 0.017 0.010 0.005 0.003 0.000 0.000

[0.13] [0.16] [0.22] [0.31] [0.35] [0.42] [0.55] [0.63] [0.75] [0.86]

Aluminum 2 0.016 0.032 0.025 0.018 0.013 0.010 0.006 0.002 0.000 0.000

[0.25] [0.16] [0.27] [0.39] [0.51] [0.58] [0.64] [0.72] [0.78] [0.86]

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

As in Table 2.