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Russia-Ukraine War and Return Predictability of Commodity Prices

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We explored the implications of the Russia-Ukraine (RUK) crisis on return predictability of selected commodity prices in the international market. We find that the crisis has a significant impact on the returns of gas, palladium, London wheat, and United States wheat. Our findings offer robust and insightful conclusions for policymakers on the heightened effect of the war on return predictability of global commodity prices.

I. Introduction

In this short communication, we explore how the Russia-Ukraine conflict has altered the value chains of several globally traded commodities and evaluate the impact of the crisis on return predictability of major world traded commodities. The two belligerent nations are major global food basket nations, providing 30 percent of the world's wheat and barley, one-fifth maize, and over 50 percent of the world's sunflower oil. Russia is the world's largest exporter of natural gas and second largest exporter of oil and accounts for about 20 percent of global fertilizer exports alongside its neighbouring nation, Belarus; these have implications for commodity prices (see, Abdul Mottaleb et al., 2022; Baffes & Ngale, 2022; Nerlinger & Utz, 2022).

The contribution of this study links the ongoing war to the vulnerability and return predictability of global commodity markets, and provides an out-of-sample forecast evaluation for robustness in our analysis. Following the classical theory of storage, and the intertemporal Capital Asset Pricing Model (CAPM), we find that the crisis has significant impact on the returns of gas, palladium, London wheat, and United States wheat. Our findings are consistent with the work of Iyke and Ho (2021) and Cotter et al. (2021, 2017), who justify the predictive power of returns on commodity prices within the in-sample and out-of-sample analyses. Section II of our communication discusses data issues and methodology, Section III presents the results and discussion, and the final section concludes our study.

II. Data and Methodology

We adopted a daily data frequency on commodity spot prices including metals, energy, and grains from investing.com and an index for the Russia-Ukraine war. We evaluated the impact of the Russia-Ukraine crisis on return predictability of major world traded commodities including

Brent, United States Corn, Gas, Nickel, Palladium, Platinum, London Wheat, United States Wheat, and WTI from the inception of the war on 02/24/2022. We present bivariate models for our empirical analysis, following the contributions of Westerlund & Narayan (2012, 2015) and adopt a single factor predictor model following the proposals of Chen et al. (2010) and Ferraro et al. (2015). We conject the Russian-Ukraine crisis as predictor of return on commodity prices and specify our baseline model as follows:

$$CP_t = \sigma + \varphi RUK_{t-1} + \varepsilon_t \quad (1)$$

where CP_t represents returns on the various commodity prices and is a vector of commodity returns captured individually in our analysis; RUK_{t-1} denotes the index for Russia-Ukraine crisis; φ provides a measure of the relative impact of the Russia-Ukraine crisis on commodity price returns; and ε_t indicates the idiosyncratic residuals on commodity prices.

Our bivariate predictive model with the volatility of various commodity prices as our predicted series and the Russian-Ukraine war index as the predictor series is presented as follows:

$$CP_t = \sigma + \varphi RUK_{t-1} + \varepsilon_t \quad (2)$$

We tested the null hypothesis (H_0), $\varphi = 0$, indicating the absence of predictive power/impact of the Russia-Ukraine crisis on commodity price returns. We address the inherent correlation between RUK and ε_t reflected in an endogeneity bias and the persistence effect from shocks by modifying our predictive model in equation (1), following the works of Lewellen (2004), Westerlund & Narayan (2012, 2015), and Salisu & Adediran (2020) to account for the potential persistence and endogeneity effects as follows:

$$CP_t = \sigma + \varphi_{adj} RUK_{t-1} + \gamma(RUK_t - \rho_0 RUK_{t-1}) + \mu_t \quad (3)$$

The φ_{adj} is introduced in equation (3) to address the persistence effect in our predictive model, and it connotes the

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OLS estimator of Lewellen (2014) which accommodates this persistence bias.

$$\varphi_{adj} = \varphi - \gamma(1 - \rho_0) \quad (4)$$

We adopted the Feasible Quasi GLS estimator, a modified OLS estimator proposed by Westerlund & Narayan (2012, 2015) to address the conditional heteroscedasticity effect. The FQ-GLS estimator pre-weights the data set and applies the OLS technique on the resulting equation. The weight applied using the FQ-GLS estimator is represented by $\frac{1}{\hat{\sigma}_\eta}$.

The FQ-GLS estimator is represented as follows:

$$\varphi_{adj}^{FQ-GLS} = \frac{\sum_{t=q_m+2}^T \tau_t^2 p_{t-1}^d S_t^d}{\sqrt{\sum_{t=q_m+2}^T \tau_t^2 (p_{t-1}^d)^2}} \quad (5)$$

$$\tau_t = \frac{1}{\hat{\sigma}_\eta} \text{ and } p_t^d = p_t - \sum_{s=2}^T \frac{p_t}{T} \quad (6)$$

We offer the descriptive and other pre-diagnostic reports of the commodities employed in our analysis in [Table 1](#) below.

III. Results and Discussion

In [Table 1](#), we report the preliminary results of the series employed in our analysis. We establish the presence of persistence and conditional heteroscedasticity for all the series employed in our analysis while an endogeneity bias was established for only London wheat (wheat_l) and United States wheat (wheat_u). Our task for this study extends to address the features of the dataset in regression of our predictability model. In Panel A of [Table 2](#), we report the impact of the RUK crisis on the return predictability of the selected commodity prices and disclose our in-sample forecast evaluation reports in Panel B. Our out-of-sample forecast evaluation reports are presented in [Table 3](#).

In Panel A of our predictability report, we established that the RUK crisis exerts a positive and significant impact on returns of gas, palladium, London wheat, and United States wheat, which is consistent with the literature that economic policy uncertainty (EPU), equity market uncertainty (EMU), and geopolitical crises have implications for commodity market volatility (Baker et al., 2016; Mei et al., 2019; Salisu & Adediran, 2020). The in-sample forecast evaluation reports in Part B reflect the disparity between our preferred and benchmark models for the predictive power of our return series. [Table 3](#) details the out-of-sample-forecast-evaluation reports for our study.

Forecast evaluation

We compared the forecast estimates of our selected return on commodity prices from equation (1) with those

from their historical average models. The historical average model depicts a fundamental predictive model for most financial, economic, and return series (Salisu & Adediran, 2020). We adopted the Clark & West-CW (2007) test which considers the RUK-based (preferred) model as superior to the historical average (benchmark) model where the null hypotheses are rejected. Our data was split in the proportion of 90:10 for the in-sample and out-of-sample forecast evaluation estimations given the scope of data employed for our study. We adopted four out-of-sample forecast evaluations over a 5-day, 10-day, 15-day, and 20-day ahead forecast time horizons.

Reports of the forecast evaluations are presented in [Table 2](#). Panel B indicates the in-sample forecast reports, and [Table 3](#) contains reports for the out-of-sample forecast evaluations. We found consistent results that our RUK index can predict returns on gas, palladium, London wheat, and United States wheat.

IV. Conclusion

The RUK crisis accurately predicts returns on gas, palladium, London wheat, and United States wheat with no evidence of predictability for Brent, WTI, nickel, platinum, and United States Corn. While our in-sample and out-of-sample forecast evaluation reports reveal the Russia-Ukraine crisis as an ideal predictor of returns on gas, London Wheat, and United States Wheat, we have conflicting reports for palladium. This study contributes to emerging studies centered on susceptibility of commodity prices and their returns to crises, including the Russia-Ukraine crisis. We introduce policy makers and stakeholders to the heightened effect of the crisis on returns of gas, London wheat, and United States wheat. This is justified, as Russia is considered as the world's largest supplier of gas, and both Russia and Ukraine provide an estimated 30% of the world's wheat.

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Table 1. Pre-estimation Diagnosis.

Statistics	Brent	Corn_u	Gas	Nickel	Palladium	Platinum	Wheat_l	Wheat_u	Wti	RUK
Mean	0.0899	0.0447	0.2257	0.0495	0.1975	0.0153	0.1050	0.1229	0.0893	41.2725
Std. Dev.	2.8493	1.8249	5.2932	6.1419	3.3140	2.0124	2.0862	2.9311	2.9634	22.8979
ADF[1(0)]	-17.1681***	-16.9756***	-19.5790***	-14.5581***	-18.3983***	-17.9720***	-13.2132***	-11.6079***	-16.8277***	-3.0151**
GARCH [1(0)]	-16.6282***	-15.6907***	-18.3656***	-18.4246***	-20.5938***	-19.8504***	-	-15.6703***	-16.0745***	-14.9914***
ARCH(5)	17.0260***	3.2200***	1.3935	80.1509***	5.6959***	0.1153	0.6655	42.8495***	16.6869***	283.0337***
ARCH(10)	10.7773***	1.8641**	0.8449	84.5945***	2.8976***	0.6069	0.9607	3.1193***	9.6227***	140.3637***
Q-stat(5)	18.985***	6.2260	7.1590	14.686**	14.879**	6.4113	6.4659	28.5777***	13.030**	1086.68***
Q-stat(10)	23.827***	13.280	8.7448	38.543***	16.589*	9.5823	15.830	35.848***	18.925**	1760.0***
Q ² -stat(5)	94.093***	21.014***	7.5970	177.60***	31.775***	0.5656	4.0751	119.35***	87.2098***	747.67***
Q ² -stat(10)	112.14***	23.625***	9.2653	181.39***	37.548***	6.4921	11.941	127.02***	117.05***	1463.9***
Persistence					0.9393*** (0.0201)					
Endogeneity	0.0119 (0.0201)	0.0152 (0.0126)	0.0260 (0.0372)	-0.0349 (0.0432)	-0.0080 (0.0233)	-0.0122 (0.0141)	0.0511*** (0.0142)	0.0357** (0.0202)	0.0081 (0.0209)	
Nobs					315					

Note: RUK represents the index for our Russia-Ukraine crisis, Corn_u, Wheat_u imply United States corn and wheat, Wheat_l implies London wheat, WTI implies West Texas Intermediate oil. I(0) implies that the ADF and GARCH unit root test statistics are conducted at the level form. ***, ** & * reflects the rejection of the underlying null hypotheses at 1%, 5% & 10% significance levels respectively. We adopt the GARCH-based test for unit root proposed by Narayan & Liu (2015). Serial correlation tests used the Q-stat(5), Q-stat(10), Q²-stat(5), Q²-stat(10) statistics with the values in parenthesis indicating the lag lengths adopted in each case.

Table 2. Predictability and Forecast Evaluation Reports

Panel A: Predictability reports									
Brent	Corn_u	Gas	Nickel	Palladium	Platinum	Wheat_l	Wheat_u	Wti	
0.0004	0.0009	0.0197***	-0.0015	0.0086***	0.0007	0.0021***	0.0091***	-0.0013	
(0.0005)	(0.0013)	(0.00002)	(0.0014)	(0.0014)	(0.0009)	(0.0003)	(0.0004)	(0.0025)	
[0.8236]	[0.6702]	[85.5964]	[-1.0339]	[6.0328]	[0.7792]	[6.6692]	[23.7041]	[-0.5123]	
Nobs 313									
Panel B: In-sample forecast evaluation									
RMSE	Brent	Corn_u	Gas	Nickel	Palladium	Platinum	Wheat_l	Wheat_u	Wti
Benchmark	2.8453	1.8225	5.2865	6.1394	3.3121	2.0091	2.0829	2.9327	2.9664
Preferred	2.8484	1.8048	5.2764	6.1401	3.3263	2.0105	2.0203	2.8746	2.9692
Nobs	313								

Note: We present our predictability and in-sample forecast evaluation reports in Parts A and B of Table 2 above. Asterisks ***, **, *, denote statistical significance at the 1, 5, and 10% levels respectively. The values of the standard error in our predictability model in Panel A are reported in parenthesis () while the values of the t-statistics are presented in square brackets. In Panel B, the RMSE-benchmark reports our evaluations for the historical average model which is also our restricted model and the RMSE-preferred reports our evaluations for our Russia-Ukraine (RUK) model which is our unrestricted model.

Table 3. Out-of-sample Forecast Evaluation

Clark & West	Brent	Corn_u	Gas	Nickel	Palladium	Platinum	Wheat_l	Wheat_u	Wti
h=5	0.0014 (0.0077) [0.1808]	-0.0043 (0.0219) [-0.1949]	0.4861** (0.2776) [1.7509]	0.2006** (0.1215) [1.6515]	0.0173 (0.1087) [0.1587]	0.0081 (0.0163) [0.4977]	0.2418*** (0.1161) [2.0824]	0.1830** (0.1097) [1.6679]	-0.0002 (0.0305) [-0.0060]
Nobs	286								
h=10	0.0015 (0.0075) [0.1989]	-0.0044 (0.0215) [-0.2058]	0.4774** (0.2729) [1.7495]	0.1950* (0.1195) [1.6323]	0.0190 (0.1069) [0.1777]	0.0061 (0.0162) [0.3789]	0.2366*** (0.1141) [2.0727]	0.1834** (0.1079) [1.6987]	0.0009 (0.0300) [0.0298]
Nobs	291								
h=15	0.0014 (0.0074) [0.1857]	0.0023 (0.0215) [0.1054]	0.4691** (0.2683) [1.7484]	0.1872* (0.1175) [1.5921]	0.0190 (0.1051) [0.1810]	0.0077 (0.0161) [0.4794]	0.2346*** (0.1122) [2.0904]	0.1823** (0.1062) [1.7163]	0.0006 (0.0295) [0.0197]
Nobs	296								
h=20	0.0015 (0.0073) [0.2045]	3.11E-05 (0.0212) [0.0015]	0.4628** (0.2639) [1.7536]	0.1854* (0.1156) [1.6035]	0.0192 (0.1034) [0.1854]	0.0100 (0.0159) [0.6271]	0.2272*** (0.1104) [2.0574]	0.1778** (0.1046) [1.7001]	0.0013 (0.0290) [0.0454]
Nobs	301								

Note: h denotes our 4 Out-of-sample forecast horizons- specified as 5, 10, 15, and 20 days respectively. Asterisks ***, ** & * denote statistical significance at the 1 %, 5 % & 10 % levels accordingly. We present the values of the standard errors of our Out-of-sample forecast evaluation reports in parenthesis () while the t-statistics are presented in square brackets. Clark & West test results are reported for our preferred model under the null. We report the Clark & West (CW) version of RMSE for our preferred-RUK model which accounts for additional predictors in a model by adjusting difference in mean squared prediction errors. We reject the null hypothesis of zero coefficient where the CW statistic exceeds +1.282, + 1.645, and +2.00 for a one sided 0.10, a one sided 0.05, and a one sided 0.01 tests respectively (CW, 2007).



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