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Commodity and Currency Correlations of the Russia-Ukraine War

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Abstract: On February 24, Russia's Special Military Operations invaded Ukraine in what became one of Europe's most significant military conflicts since the Cold War. Meanwhile, this military operation inevitably affected the rest of the world instead of only being a localized engagement. For instance, the USA and western Europe went on high alert about the impact of the invasion on the global economy. These fears were confirmed as the world economy followed a path affected by the Russia-Ukraine crisis, particularly concerning commodities and currency. In one of our recent studies, we investigated the correlation between commodities and currencies. During our research, we looked at the link between past localized conflicts and how they impacted various nations' commodity prices. The relationship between the two variables can explain the significant damage to a country's production and export capacity and the driving force behind inflation. In this dataset, we first calculate the correlation ratios based on evidence such as the production and export of oil, wheat, and the state of the Russian currency (rubles). The changes in these aspects were investigated before and during the war, as the conflict is still ongoing. Then, we combine these correlations with similar conditions in other conflicts to conclude. Finally, we empirically investigate the correlations between these commodities and currencies.

Keywords: commodity, currency, Russia, Ukraine

1. Introduction

Due to the war between Russia and Ukraine, the prices of some bulk commodities in Russia have changed significantly. Also, the exchange rate between the ruble and the US dollar also significantly shifted. In that respect, there is reason to believe there is a particular link between bulk commodities and the exchange rate. In addition to the immeasurable human suffering and severe economic disruption, economic devastation worldwide followed. The destruction of production sites, disruption of supply chains, and displacement of people led to sudden and lasting disorders in economic activity. While we do not have much general empirical evidence on the financial losses caused by this war, history experts have coined the term "reverse development" to describe war events in which the negative economic impacts persist. Such a phenomenon is also evident in the aftermath of the war in Ukraine. Only a few weeks after Russian forces began their invasion of Ukraine, millions of people left the country. At the same time, international parties have imposed sanctions on Russia on an unprecedented scale that threaten to severely damage the country's economy, which will end decades

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of economic cooperation. Nevertheless, despite intense discussions in various countries on a political and economic level, an embargo on oil and gas imports from Russia has not yet been implemented, as several European powers fear the financial consequences of losing these hard-to-replace imports. It is also fair to say that Russia's occupation of Ukraine's agriculturally rich land will only raise the cost of food. Russia's invasion has also already severely impacted the stock market. The crisis has led to short-term market volatility. The market volatility may leave a mark on the careers of financial investors that have chosen to remain in business, despite the lack of predictability associated with economies during times of conflict. However, it has led to a loss of investor confidence and control over spending. Meanwhile, the cryptocurrency market has also crashed, and some experts connect it to the conflict between the two countries.

2. Recent study

A 2016 study of Russian agricultural products used impulse response technology to solidify these links. The results showed no causal relationship between the price of Russian farm products and the exchange rate [1]. Meanwhile, a separate study confirmed that, for bulk commodities like oil, a country's exchange rate is impacted by the efficiency of the national financial market instead of bulk commodities alone [2]. However, the article published in the International Journal of Central Banking in 2021 showed that commodities have a driving effect on exchange rates, and the relations between commodity prices and exchange rates have nothing to do with global risks [3]. After the Russia-Ukraine war in 2014, Russian goods were sanctioned by Western Europe and other countries, and commodity prices increased. The exchange rate was also affected to some extent, although the exact relationship between the ruble's exchange rate vis-à-vis the US dollar remains inconclusive. While a relationship exists, existing data, mainly research published by Research in International Business and Finance, shows no direct relationship between sanctions on the ruble-dollar exchange rate. The study was conducted using pooled empirical modal decomposition and Hurst index analysis, suggesting that there is no direct link between these commodity prices and exchange rates. However, it is shown in the Journal of Comparative Economics: that the analysis using the VAR model reveals that most of the ruble depreciation is related to the decrease in oil prices, which means that most of the exchange rate is influenced by this category of goods.

In this essay, we will analyze four columns of data about the daily prices of crude oil, wheat, gold, and nickel from 2017 to 2022 and 2 columns of data about the day-to-day exchange rate between the US dollar and the ruble of Russia and between the US dollar and the Hryvnia of Ukraine. The unit of crude oil is the price per barrel. The unit of wheat is the price per 0.1 bushels. The unit of gold is the price per 0.1 ounce, and the unit of nickel is the price per 0.01 ounce. All the prices are from the beginning of 2017 to September 11th of, 2022. We want to see whether there is a relationship between the daily prices of farm products and the exchange rate between the US dollar and the Ruble and Hryvnia. We suppose that the sanction of the west against Russia and the Russo-Ukrainian war will affect the exchange rate and the daily prices of the products such as crude oil and wheat. We plan to do a linear regression with the x coordinate being the four columns of the costs of the products and the y coordinate being the daily exchange rate. And using the result from the linear regression, we can analyze whether or not there is a high correlation between everyday prices and the exchange rates.

3. Data Analysis

First, it is vital to establish that the standard deviation would suggest the fluctuation of commodities prices. During the war, nickel and ruble got much more volatile; wheat got somewhat more volatile. This phenomenon is expected during the war when the market and society lose stability, resulting in changing currency and price of commodity goods. However, the war made the hryvnia (the Ukrainian

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currency) less volatile [4]. As a result of stricter regulations on foreign exchange purchases and remittances abroad, administrative control levers became more vital in controlling non-productive capital outflows. At the same time, the National Bank of Ukraine intervened in the currency market by buying and selling foreign exchange operations, smoothing out the shock peaks of foreign exchange demand and supply. As for the energy sector, crude oil got less volatile. On the supply side, although Russia's crude oil exports to Europe decreased by about 1.2 million, exports to other regions increased, which balanced the overall exports. The US and Norway have increased their European exports by about 1 million to supplement the EU's crude oil imports. As a result, the supply of crude oil remains in balance [5]. Furthermore, gold got much less volatile. The gold reserve is an effective way for the Russian Central Bank to maintain its exchange rate. Thus, the government should keep the gold price at a constant level to help their currency become better.

Table 1: Daily Products log Returns Before and During the War [Owner-draw]

	U/R	U/H	Crude Oil	Wheat	Gold	Nickel
Before War Mean	0.02%	0.01%	0.08%	0.09%	0.03%	0.09%
SD	0.81%	0.53%	3.08%	1.90%	0.89%	3.13%
During War Mean	-0.25%	0.03%	0.19%	-0.22%	0.02%	-0.16%
SD	11.20%	0.07%	3.58%	4.14%	1.00%	10.49%

Table 1 shows the returns of Daily Products before and during the war. From this table we analyze the correlations between those commodities and currency. Before the war, all correlations are near zero, except for the correlation between crude oil and the ruble. During the war, the currency correlations went up significantly. Both currencies strengthened, particularly the Russian ruble, which depends on the country's gold reserves. This, again, can be explained by the correlation between Russia's gold reserves and its currency. It is also logical to assume that the ruble could become even more expensive in the future. On the other hand, Europe's support for Ukraine will help improve the hryvnia while potentially restricting the development of Russia's economy. To that end, wheat and hryvnia show a stronger correlation.

However, the research shows difficulties in selling Ukrainian commodities. According to the chairman of the Ukrainian Grain Association, Ukraine is facing a difficult situation that experts have not seen in the past three decades. The country, as it turns out, has never encountered such a problem before, and as of this writing, no clear solutions exist that will alleviate their current economic challenges. The exchange rate of the hryvnia also reflects the financial situation of Ukraine. Thus, wheat and hryvnia have a strong correlation, and although gold and wheat are also correlated, their link is mild. Crude oil and nickel have a stronger correlation [6]. This is understandable because the changes in the value of both commodities are repercussions of the Russian and Ukrainian economic situations. In addition, because America and Europe will likely restrict the export of Russian goods, the price of specific commodities will increase sharply due to the lower supply. While the wheat stored in Ukraine has a lower price, the oil price increased significantly, leading to a negative correlation between the two. Table 2 shows the intrinsic relationship between Commodities and Currency before the war.

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Table 2: The Correlations Between Commodities and Currency Before the War [Owner-draw]

Before War Covariance Matrix							
	U/R	U/H	Crude oil	Wheat	Gold	Nickel	
U/R	0.000065	0.000002	0.000015	0.000003	0.000002	0.000002	0.000065
U/H	0.000002	0.000028	0.000006	0.000002	0.000001	0.000008	0.000028
Crude oil	0.000015	0.000006	0.000949	0.000025	0.000015	0.000011	0.000949
Wheat	0.000003	0.000002	0.000025	0.000361	0.000000	0.000016	0.000361
Gold	0.000002	0.000001	0.000015	0.000000	0.000080	0.000010	0.000080
Nickel	0.000002	0.000008	0.000011	0.000016	0.000010	0.000977	0.000977
	0.000065	0.000028	0.000949	0.000361	0.000080	0.000977	
	U/R	U/H	Crude oil	Wheat	Gold	Nickel	
U/R	1.00	0.05	0.06	0.02	0.03	0.01	
U/H	0.05	1.00	0.04	0.02	0.03	0.05	
Crude oil	0.06	0.04	1.00	0.04	0.05	0.01	
Wheat	0.02	0.02	0.04	1.00	0.00	0.03	
Gold	0.03	0.03	0.05	0.00	1.00	0.04	
Nickel	0.01	0.05	0.01	0.03	0.04	1.00	

Table 3: The Correlations Between Commodities and Currency During the War [Owner-draw]

During War Covariance Matrix								
		U/R	U/H	Crude oil	Wheat	Gold	Nickel	
0.000065	U/R	0.012415	0.000124	0.000009	0.000016	0.000020	0.000854	0.012415
0.000028	U/H	0.000124	0.000049	0.000035	0.000032	0.000009	0.000105	0.000049
0.000949	Crude oil	0.000009	0.000035	0.001266	0.000265	0.000047	0.000736	0.001266
0.000361	Wheat	0.000016	0.000032	0.000265	0.001705	0.000024	0.000165	0.001705
0.000080	Gold	0.000020	0.000009	0.000047	0.000024	0.000099	0.000033	0.000099
0.000977	Nickel	0.000854	0.000105	0.000736	0.000165	0.000033	0.010888	0.010888
		0.012415	0.000049	0.001266	0.001705	0.000099	0.010888	
		U/R	U/H	Crude oil	Wheat	Gold	Nickel	
	U/R	1.00	0.02	0.00	0.00	0.02	0.07	
	U/H	0.16	1.00	0.14	0.14	0.13	0.14	
	Crude oil	0.00	0.14	1.00	1.00	0.13	0.20	
	Wheat	0.00	0.11	0.18	0.18	0.06	0.04	
	Gold	0.02	0.13	0.13	0.13	1.00	0.03	
	Nickel	0.07	0.14	0.14	0.20	0.03	1.00	

Table 3 shows the intrinsic relationship between Commodities and Currency in the aftermath of the war. After calculating the given correlations, we were set to find which commodity influences the currency most. Before the war, five variables, which included oil, wheat, gold, crude oil*gold, and crude oil/wheat, proved to be the most suitable for the regression model for hryvnia. All five variables and their price changes will significantly impact the hryvnia. Then, during the war, crude oil, nickel, wheat, oil/wheat, and wheat*nickel became the most suitable variables for the regression model [7]. The wheat and wheat*nickel correlations carried the most significant effects of these five. In contrast,

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the other variables have little impact on the hryvnia. This can be explained by the fact that wheat is one of the largest sources of government revenue in Ukraine [8,9]. Regression Statistics for commodities before the war are shown in Table 4.

Table 4: ANOVA Before the War-H[Owner-draw]

Regression Statistics	
Multiple R	0.474559
R Square	0.225206
Adjusted	0.222305
Standard	1.012605
Observatio	1341

ANOVA

	df	SS	MS	F	Significance F
Regression	5	397.8837	79.57675	77.60894	1.51E-71
Residual	1335	1368.867	1.025369		
Total	1340	1766.751			

	Coefficient	Standard	Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	5.094538	1.27745	3.988051	7.02E-05	2.588509	7.600567	2.588509	7.600567
C	-0.09111	0.0255	-3.57313	0.000365	-0.14114	-0.004109	-0.14114	-0.04109
W	0.270573	0.01871	14.46154	3.82E-44	0.233869	0.307277	0.233869	0.307277
CW	0.116295	0.00923	12.59936	1.79E-34	0.098187	0.134402	0.098187	0.134402
CG	-0.08906	0.010167	-8.75907	5.85E-18	-0.109	-0.06911	-0.109	-0.06911
G	0.047295	0.005495	8.607379	2.07E-17	0.036515	0.058074	0.036515	0.058074

Table 5: ANOVA During the War-H[Owner-draw]

Regression Statistics	
Multiple R	0.560172
R Square	0.313792
Adjusted	0.276499
Standard	0.231859
Observatio	98

ANOVA

	df	SS	MS	F	Significance F
Regression	5	2.261635	0.452327	8.414045	1.38E-06
Residual	92	4.945789	0.053759		
Total	97	7.207425			

	Coefficient	Standard	Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	38.67346	2.567604	15.06208	1.44E-26	33.57398	43.77294	33.57398	43.77294
C	-0.01701	0.009147	-1.85934	0.066175	-0.03518	0.001159	-0.03518	0.001159
W	-0.07181	0.022805	-3.14865	0.002212	-0.1171	-0.02651	-0.1171	-0.02651
N	-0.02638	0.006609	-3.99107	0.000132	-0.0395	-0.01325	-0.0395	-0.01325
CW	0.003175	0.008661	0.366574	0.714778	-0.01403	0.020376	-0.01403	0.020376
WN	0.024002	0.005928	4.04859	0.000107	0.012228	0.035777	0.012228	0.035777

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Regression Statistics for commodities during the war are shown in Table 5. The ruble showed similar variable suitability for their regression model. The variables oil, wheat, gold, crude oil*gold, and crude oil/wheat fit best in their specific context. While wheat has little effect on the ruble, all other variables have a significant impact. If the prices of commodities decrease, the Russian government's fiscal revenue and foreign trade volume will decline, which would lead to the collapse of the ruble exchange rate and fast-rising inflation [10]. During the war, five variables, oil, wheat, gold, crude oil*gold, and crude oil/wheat, suited the regression model the most. All variables have a significant effect, except for crude oil/wheat, which has a substantial impact. Meanwhile, crude oil and wheat decrease in value and price because America restricts the sale of those two commodities [11]. Regression Statistics for commodities before the war are shown in Table 6.

Table 6: ANOVA Before the War-R[Owner-draw]

Regression Statistics	
Multiple R	0.904868
R Square	0.818787
Adjusted	0.818108
Standard	2.863924
Observatio	1341

ANOVA

	df	SS	MS	F	Significance F
Regression	5	49474.87	9894.973	1206.401	0
Residual	1335	10949.75	8.202063		
Total	1340	60424.62			

	Coefficient	Standard	Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	8.107673	3.61298	2.24404	0.024993	1.019935	15.19541	1.019935	15.19541
C	0.980236	0.07212	13.59172	1.67E-39	0.838755	1.121717	0.838755	1.121717
W	0.123867	0.052917	2.340806	0.019389	0.020059	0.227676	0.020059	0.227676
CW	-0.15198	0.026106	-5.82184	7.28E-09	-0.20319	-0.10077	-0.20319	-0.10077
G	0.368393	0.01554	23.70552	5.7E-09	0.337907	0.398879	0.337907	0.398879
CG	-0.50597	0.028756	-17.5951	1.74E-62	-0.56238	-0.44956	-0.56238	-0.44956

Table 7: ANOVA During the War-R[Owner-draw]

Regression Statistics	
Multiple R	0.769656
R Square	0.59237
Adjusted	0.570216
Standard	14.51659
Observatio	98

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ANOVA

	df	SS	MS	F	Significance F
Regression	5	28173.69	5634.737	26.73897	1.34E-16
Residual	92	19387.27	210.7312		
Total	97	47560.96			

	Coefficient	Standard	Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	5129.467	763.096	6.721915	1.48E-09	3613.892	6645.041	3613.892	6645.041
C	-44.6116	7.384712	-6.04108	3.21E-08	-59.2783	-29.945	-59.2783	-29.945
W	-2.50341	0.573735	-4.36336	3.34E-05	-3.6429	-1.36393	-3.6429	-1.36393
CW	-1.58976	0.55341	-2.87265	0.005053	-2.68888	-0.49064	-2.68888	-0.49064
G	-24.3189	3.959229	-6.14232	2.05E-08	-32.1822	-16.4555	-32.1822	-16.4555
CG	23.46918	3.888182	6.036029	3.28E-08	15.74691	31.19144	15.74691	31.19144

Regression Statistics for commodities during the war are shown in Table 7. It is evident that, overall, the prices were much higher in 2022. However, the change in currency stability appears anomalous. Typically, the war is expected to decrease the value of currencies, mainly because the US dollar has become more potent in 2022. Russia's overall export rate dropped since Russia faced embargos and sanctions from western countries. The commodity prices increased because of the change in the export rates, especially crude oil and wheat. The central bank in Russia set restrictions that make it harder to exchange rubles for other currencies. The Russian government also implemented several policies that required consumers and buyers alike to use rubles for oil and other products from the energy sector, which pushed the ruble's value upwards.

4. Conclusion

By comparing and analyzing a large amount of data on commodity prices before and after the Russian-Ukrainian war, it can be concluded that whether the Russian-Ukrainian conflict as a whole will significantly change the global economy and, to a lesser extent, their economy depends on the scope of the problem and that military action has some degree of influence. the price of commodities shows a positive correlation with the value of currency. The current struggle will provide new data on how commodities and currencies will change. More data is needed to further examine past military conflicts and how they have affected the countries involved. In the future, this study will provide a more accurate analysis of the commodity and currency correlations between the countries involved in the Russian-Ukrainian war and the past experiences of the countries involved in the war, and create an accurate system to predict the impact of future wars on commodity and currency and make appropriate recommendations.

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