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A wavelet-based time-frequency dependency and safe haven attributes of gold: evidence from the Russia–Ukraine war

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ABSTRACT

In the context of the Russia–Ukraine war, this study examines the dependence structure and evaluates the safe haven attributes of gold for equity in the time-frequency domain. We use the wavelet coherence analysis for the leading stock markets and gold prices. Empirical results indicate that gold can be regarded as a safe haven for France, Italy and German stock markets only during the early phase of the war as the market regained quickly from the downturn. Further, in the long-run, a few evidences of positive connectedness demonstrate the diversifier property of gold against stocks. These contributions may be useful for portfolio investors that are desirous of managing and readjusting their portfolio with gold and equity in times of market turmoil.

KEYWORDS

Gold; stock; safe-haven; Russia–Ukraine war; wavelet

JEL CLASSIFICATION

C22; G01; G11; G15

I. Introduction

For several decades, the yellow metal has outshined major financial asset classes, establishing a strong position in terms of investor acceptance. It uses to shelter investment real value against crisis, inflation, government, institution and individual unprecedented actions (Wang, Lee, and Nguyen Thi 2011). There are many good reasons to explain why gold is inevitably considered a safe haven against the various classes of assets. From the historical perspective, directly or indirectly, gold exhibits the unique attribute of having a negative correlation with other financial assets or a portfolio under extreme market conditions. For instance, at the beginning of the Covid −19, when stock prices tumbled sharply, gold prices rose by a whopping 15% (Paramati, Abedi Shamsabadi, and Reddy Kummitha 2022). However, in a recent turbulent time caused due to various factors such as fear of recession, the global economy slowing down and the Russia–Ukraine war, the gold prices seem to not highly glittered. Since the Russia–Ukraine conflict surfaced on 24 February 2022 till 23 April 2022, the gold market prices have increased by barely 3.17%, but subsequently, it has slumped by −9.58% (30 August 2022) and a −3.85% decline by 23 February 2023. At the same time, the stock prices of leading economies contracted by 5% during the span of the initial 6 months and recouped their performance by 23 February 2023. Therefore, does this anomaly indicate that the investors have disregarded the demand for safe haven assets during the invasion period? Chen and Wang (2019), argued that the gold hedge and safe haven potential could vary across different market conditions. Hence, this is an imperative debatable issue.

Pointing towards this fact, we can recall several studies dwell attention to gold safe haven themes (Baur and Lucey 2010; Baur and McDermott 2010; Gürgün and Ünalmış 2014). Past studies have claimed gold acts as a short-lived safe asset (Baur and Lucey 2010); a better fit as a diversifier (Paramati, Abedi Shamsabadi, and Reddy Kummitha 2022); a weak safe haven for stock (Dar and Maitra 2017); not a robust safe haven asset (Lucey and Sile 2015); substantially strong/weak safe haven asset in the turmoil period (Nguyen et al. 2020).

The foregoing research findings regarded gold as a store of value, a diversifier, and a strong/weak safe haven tool for risky assets. Thus, under the wavelet time-frequency framework, by examining the dynamic dependence structure, we assess whether gold has exhibited safe haven behaviour during the Russia–Ukraine turmoil.

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II. Data and methods

Our dataset consists of the top ten countries' equity indexes and gold prices. The daily data observation retrieve from https://in.investing.com/ and https://www.gold.org/ for a sample period from 24 February 2022 to 23 February 2023 (a period of the Russia–Ukraine war). The price series for each stock index and gold is transformed into returns by applying $R_t = \ln (P_t/P_{t-1})*100$.

Next, a robust method, wavelet coherence (WTC), is employed to detect the co-movement between gold and stock and whether gold reflects the safe haven attributes on a time-frequency domain. The estimation is crucial to the market participants operating over different investment horizons. Christopher and Compo (1998) introduce the cross-wavelet transform of two variables x(t) and y(t) on a time-frequency scale as;

Wxy (v, s) = Wx(v,s) Wy(v,s), where Wxy (v,s) are continuous wavelet transforms, v and s are the position index and scale.

Based on that, WTC between two return series is stated as follows:

$$R^2(\tau,s) = \frac{\left|S\left(\frac{1}{S}W_{xy}(\tau,s)\right)\right|^2}{S\left(\frac{1}{S}\left|W_x(\tau,s)\right|\right)S\left(\frac{1}{S}\left|W_y(\tau,s)\right|\right)} \quad (1)$$

To refer to the correlation between series, the coherence takes a value between $0 \le R^2$ (v,s) ≤ 1.

In addition, the lead–lag relationship between gold and stock is drawn on their wavelet-phase angle. The coherence-phase difference equation of (Christopher and Webster 1999) is depicted as:

$$\rho_{xy}(\tau,s) = tan^{-1}\left(\frac{lm\left[S\left(\frac{1}{S}W_{xy}(\tau,s)\right)\right]}{Re\left[S\left(\frac{1}{S}W_{xy}(\tau,s)\right)\right]}\right),\ \rho_{xy}[-\pi,\pi] \quad (2)$$

Where Im and Re are the imaginary components of the wavelet coefficient. The different angle phases are indicated by arrows on a wavelet coherence plot.

III. Results and discussion

Table 1 reports the summary statistics of the stock and gold returns. To test the assertion of inverse direction, it is true for Germany, India, the UK, France, Italy, Canada and South Korea, but the strength of the negative correlation is substantially lower (Table 1). However, during the turmoil period, gold has shown a positive movement with the US, China and the Japanese stock market. Initially, we plot gold and stock price co-movement for all ten countries (Figure A1).

Wavelet coherency and gold as a safe haven

The wavelet coherence results are reported in Figure 1(a-j) By the definition of Baur and Lucey (2010), gold indicates a safe haven when it is uncorrelated or negatively correlated with equity in extreme market conditions (crisis). Scale – X represents the time horizon and scale – Y depicts the frequency domain. The blue region signifies low coherency, while the red reflects high dependency. The directional arrows point out the sign of dependence. The colour palette inside the black-line pockets

Table 1. Estimates of descriptive statistics and correlation.

Variables	Mean Return	Standard deviation	Skewness	Kurtosis	Jarque-Bera	Correlation Stock and Gold
Panel A: Stock returns						
US	−0.0256	1.4710	−0.0689	3.6117	4.2596	0.0413
China	−0.0163	1.0672	−0.8134	6.9185	195.0174**	0.0112
Japan	0.0164	1.1732	0.0963	3.6585	5.0994*	0.0730
Germany	0.0371	1.3849	0.4461	6.5492	145.0906**	−0.2661
India	0.0288	0.9576	0.0001	3.4791	2.4871	−0.0599
UK	0.0357	0.9509	−0.1611	5.4855	68.0486**	−0.1551
France	0.0443	1.3249	0.3413	6.3546	126.9586**	−0.2548
Italy	0.0354	1.4776	−0.3560	6.1132	110.4860**	−0.2073
Canada	−0.0108	0.9920	−0.1604	3.6620	5.8625*	−0.1228
South Korea	−0.0317	1.1104	−0.1190	3.2126	1.1029	−0.3386
Panel B: Gold returns						
US	−0.0225	0.9040	0.2418	4.2662	19.9018**	
China	0.0106	0.8725	0.1778	4.0759	13.9097**	
Japan	0.0367	0.9642	−0.0559	4.1742	15.0726**	
Euro	−0.0042	0.8657	−0.4494	6.5853	148.0034**	
India	0.0119	0.9229	0.0159	4.3237	18.9923**	
UK	0.0156	0.9257	0.0146	5.3301	58.8285**	
Canada	−0.0030	0.8622	−0.0242	5.7628	82.7191**	
South Korea	0.0066	1.0288	0.1748	3.9143	10.3798**	

Note: ** and * indicates 5% and 10% significant level.

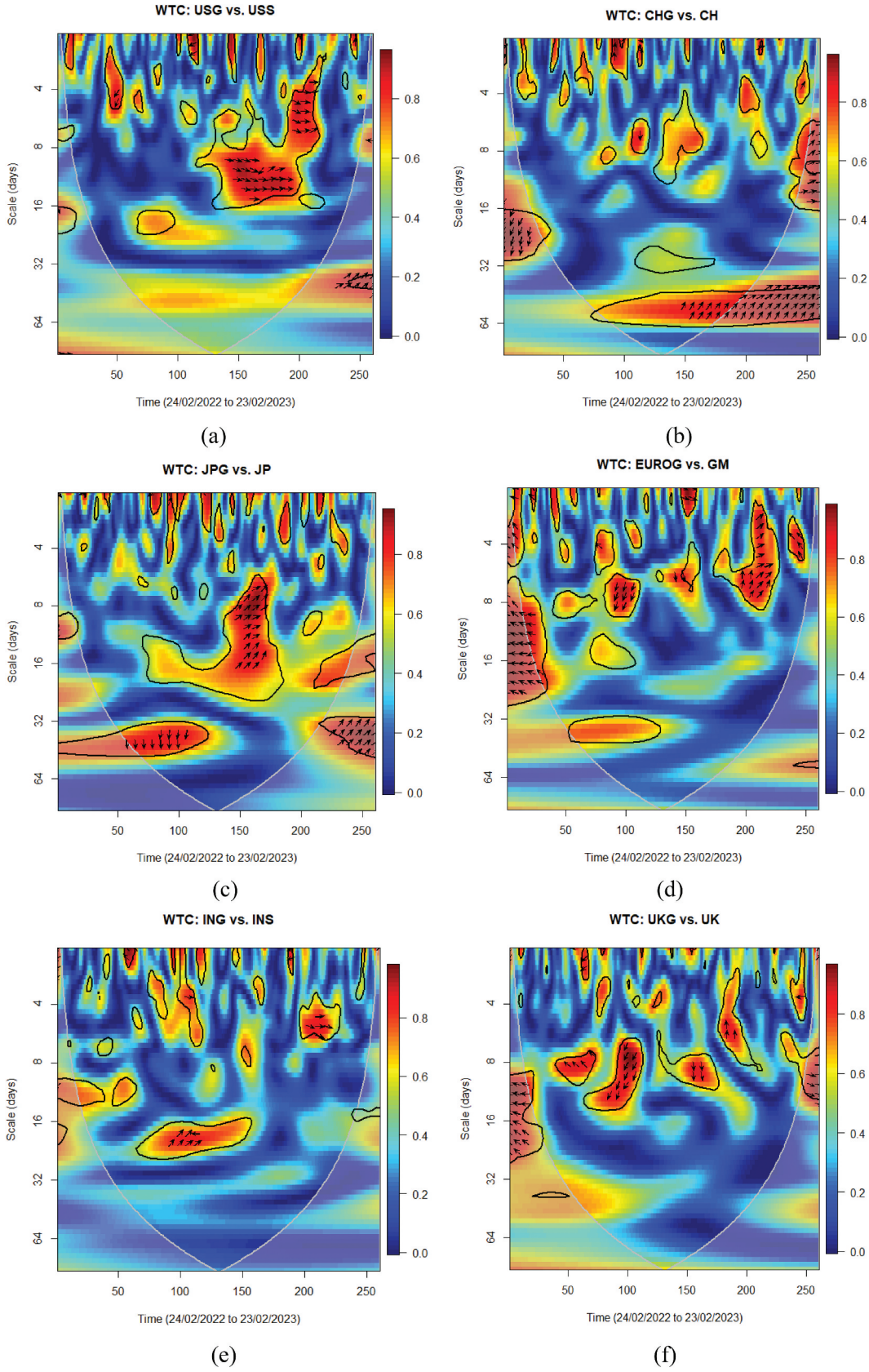

Figure 1. Wavelet coherence. (a) WTC: US gold and stock. (b) WTC: China gold and stock. (c) WTC: Japan gold and stock. (d) WTC: Europe gold and German stock. (e) WTC: India gold and stock. (f) WTC: UK gold and stock. (g) WTC: Europe gold and France stock. (h) WTC: Europe gold and Italy stock. (i) WTC: Canada gold and stock. (j) WTC: South Korea gold and stock. The phase angles; west and east point arrows designate negative and positive correlation; north, south, northeast and southeast specify the gold lead the equity; and southwest and northwest arrows point out the equity lead the gold.

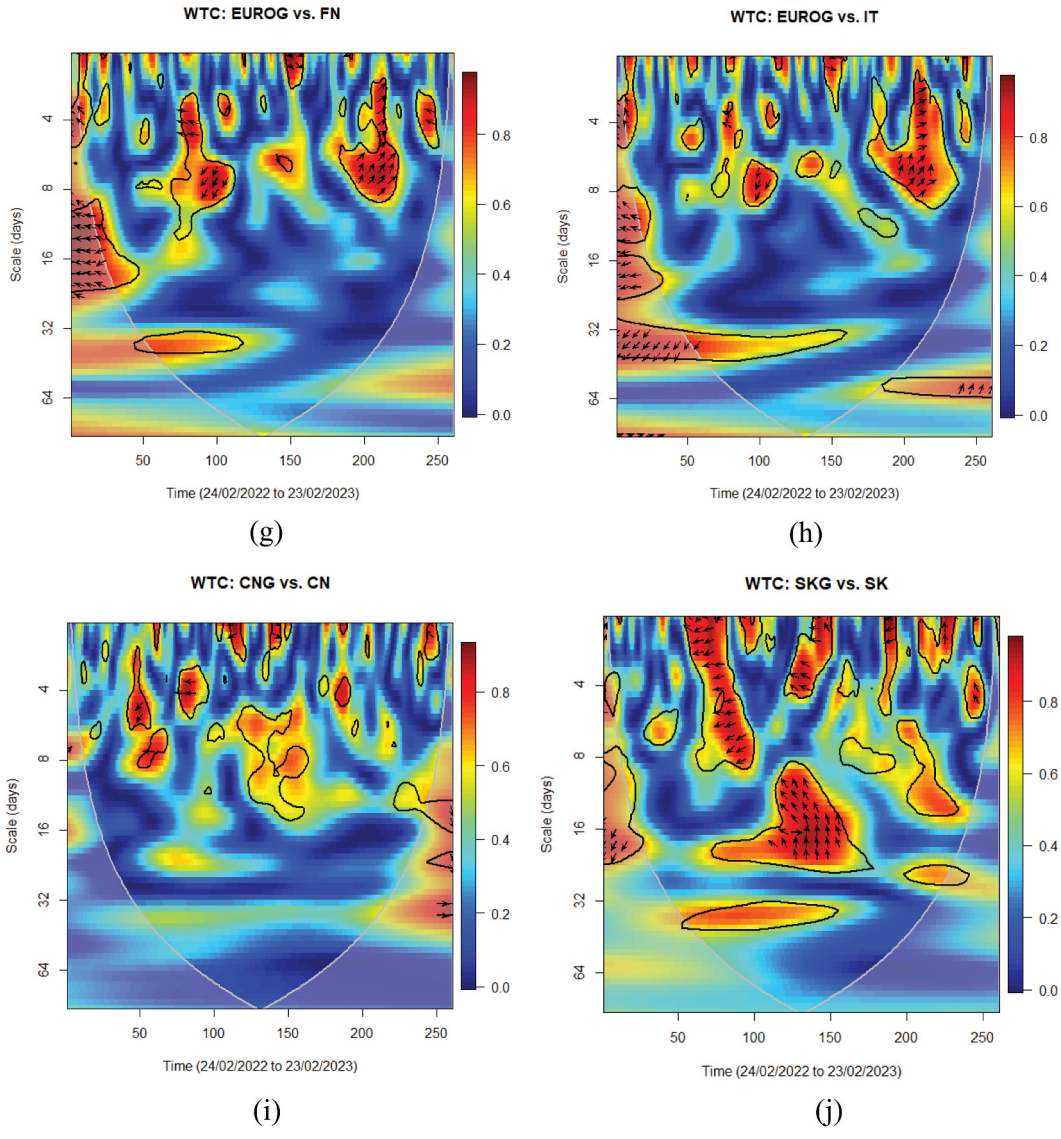

Figure 1. (Continued).

distorts the coherence at a 5% significant level. It can be seen that the coherency results across the time and frequency horizon do not vary much for the top ten economies. Most of the region in the plot is dominated by cold colours. However, in a short-term investment horizon (upto 16 days), investors believe several significant black contours indicate a high dependency between gold and equity. When evaluated over one year of invasion period, the results show most of the arrows in the figure pointing towards south, north, northeast and east. More specifically, unlike the global financial crisis and Covid-19, during the Russia–Ukraine war, it seems that the US, China, Japan, India, UK and Canada stock markets variability were not extreme for long, so gold does not react as a safe haven asset. Rather, we infer that gold leads the equity and can be regarded as a portfolio diversifier. Paramati et al. (2022), also find a similar result. In particular, the Figures d, g and h show that at the early stage of the Russia–Ukraine conflict, the investors chose gold as a safe haven for Germany, Italy and France equity market volatility and sold it quickly when they regained confidence and recouped the market with lower volatility. These findings are relative to the claim of (Baur and McDermott 2010; Gürgün and Ünalmış 2014)

that the safe haven property of gold is short-lived for developed markets during the crisis. Furthermore, the results of Figure j illustrate a negative association of gold with South Korean equity for a short investment horizon between 13 June 2022 to 29 July 2022, which reflects the safe haven phenomena of investors (Baur and Lucey 2010). Overall, the results suggest that gold exhibits safe haven characteristics when volatility increases and if the extreme level decreases, it may act as a diversifier for stock investors.

IV. Conclusion

Using the wavelet coherence approach, we examined the dependence structure and assessed the safe haven behaviour of gold corresponding to the one-year Russia–Ukraine war. The results provide the support that gold behaves as a safe haven for France, Germany and Italy equity markets only at the start of the war, indicating the quick recovery of the market from the uncertainty. Nevertheless, the dependency varies across the different time and frequency domains, and gold can be regarded as a portfolio diversifier for most of the stocks in the long-run. The finding of our study provides information to policymakers and investors to adjust their policy decision related to safe-haven assets considering the reported evidence. Future research could extend the interaction between gold and the number of financial assets, including virtual currencies and green market assets and examine the safe haven hypothesis with different investment horizons under a series of financial events.

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Appendix

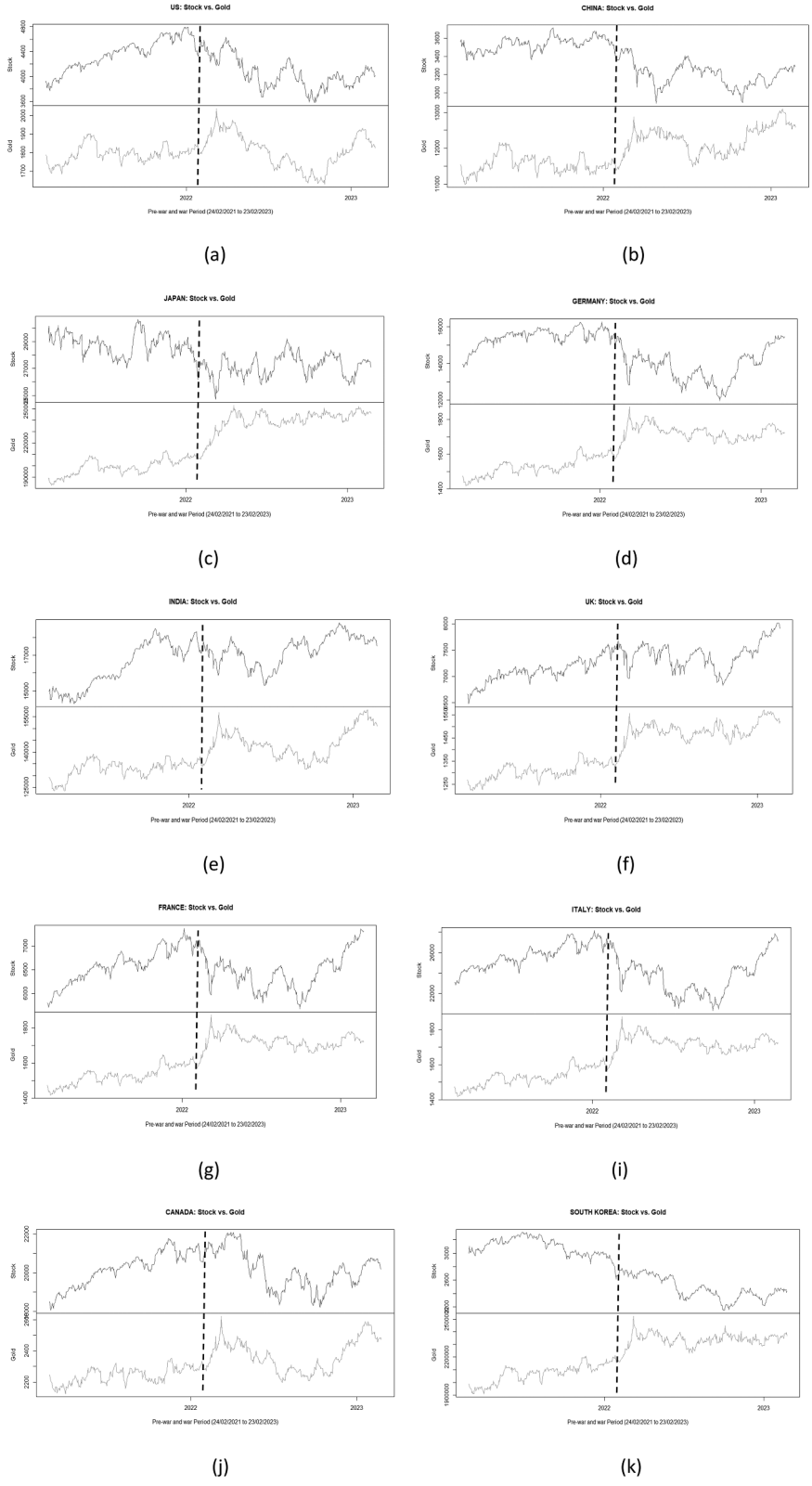

Figure A1. Stock prices vs. Gold prices movement (24 February 2021 to 23 February 2023).