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Precious Metal Prices: A Tale of Four U.S. Recessions

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ABSTRACT

Precious Metal Prices: A Tale of Four U.S. Recessions

This paper empirically examines the degree of persistence in four precious metal prices (i.e., gold, palladium, platinum, and silver) during the last four U.S. recessions. Unit root tests and fractional integration techniques suggest that gold still is the most prominent safe haven asset within this particular asset class. Our analysis highlights gold's traditional role as a hedge against market uncertainty in post-pandemic new era, thus retaining its status quo as a store of value during economic contractions.

JEL Classification: G10, G11, G15, F10

Keywords: precious metal prices, U.S. recessions, persistence, COVID-19

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1. Introduction

This paper delves into the price movements of four precious metals: gold, palladium, platinum, and silver. The role of precious metals as a safe haven asset has been previously studied in the financial literature (see, for example, Lucey and Li, 2015; Li and Lucey, 2017). Financial portfolios that contain precious metals perform better than standard equity portfolios (see, for example, Hillier et al., 2006; Low et al. 2016). Furthermore, empirical evidence shows that precious metals combined with certain sets of currency markets (Mensi et al., 2020) or cryptocurrency markets (Kabir Hassan et al., 2021) may play a role in portfolio diversification and investment protection against the downside risk.

In this paper we empirically examine the persistence in price movements for precious metals during U.S. recessions. We employ daily price data for gold, palladium, platinum and silver running from July 2, 1990 to March 21, 2022. Following the dating of business cycles in the U.S. (NBER, 2022), our selected sample period includes the last four recessions: July 1990-March 1991; March 2001-November 2001; December 2007-June 2009, and February 2020-April 2020.

The methodology employed in this paper is based on fractional integration, which is more general and flexible than other methods that simply consider integer degrees of differentiation. In addition, it allows us to consider nonstationary though mean-reverting processes if the order of integration is, for example, in the [0.5, 1) range.

Our research is related to several strands of the literature. First, we contribute to the commodity markets and finance literature on precious metal prices modelling. For example, previous studies such as Gil-Alana et al. (2015a) find that the orders of integration are equal to or higher than 1 in the majority of the precious metal prices examined. Also, using annual data from 1833 to 2013 for gold and from 1792 to 2013 for silver, Gil-Alana et al. (2015b) conclude that the real price of gold is non-mean reverting while that of silver's is mean reverting.

Second, we also contribute to the literature on commodity markets and business cycles with a focus on recessionary periods. Fama and French (1988) find that precious metal prices are explained by a significant business cycle component, while Kucher and McCoskey (2017) indicate that the long-run relationships among precious metal prices are strongly influenced by economic conditions. This paper is closely related to Kinateder et al. (2021) who find that gold has remained a safe haven asset during the last two recessions (Global Financial Crisis and Covid-19).

Finally, we contribute to the emerging literature that provides empirical evidence based on the Covid-19 shock. This study is also closely related to Yarovaya et al. (2022) who examine and compare financial market reaction and recovery of precious metals, concluding that gold offers limited mean reversion while platinum shows very strong resistance to the Covid-19.

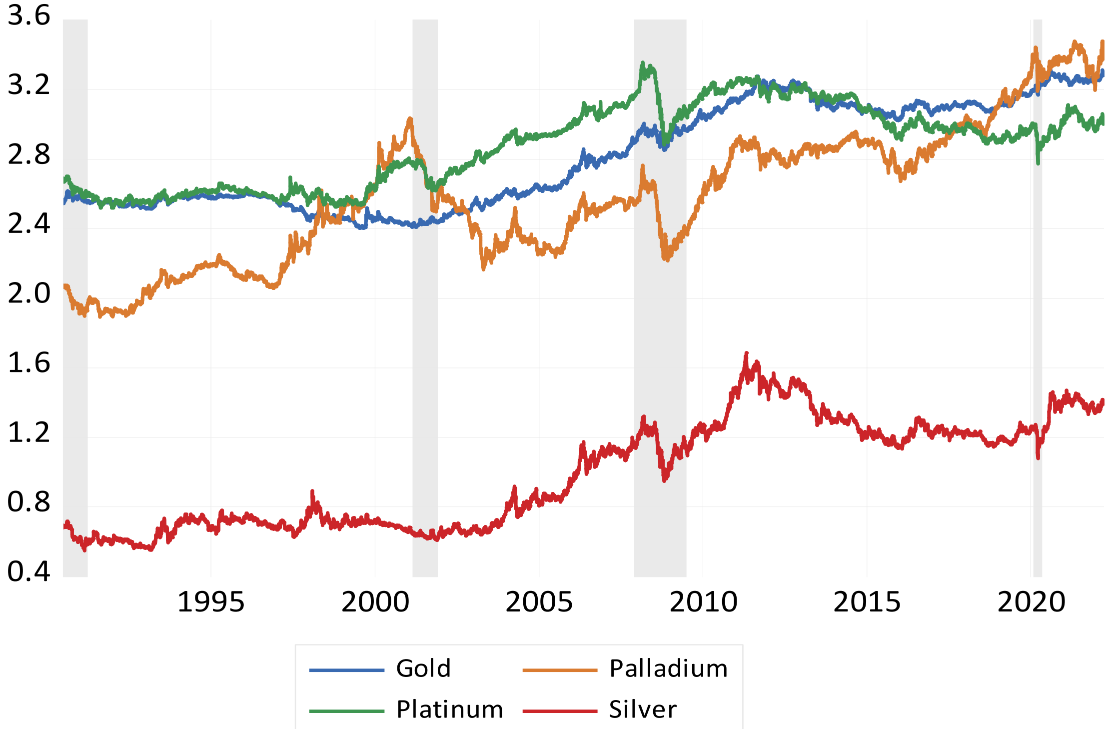
The remainder of this paper proceeds as follows. Section 2 presents a first look at precious metal prices during U.S. recessions. Section 3 reports the empirical findings using both unit root tests and fractional integration techniques. Finally, Section 4 concludes.

2. A first look at the data

We use daily observations from Refinitiv Datastream on spot prices for gold, palladium, platinum, and silver. All the prices are expressed in U.S.$ per troy ounce and the sample period runs from July 2, 1990 to March 21, 2022. The dating of U.S. business cycle recessions is provided by the NBER's Business Cycle Dating Committee (NBER, 2022).

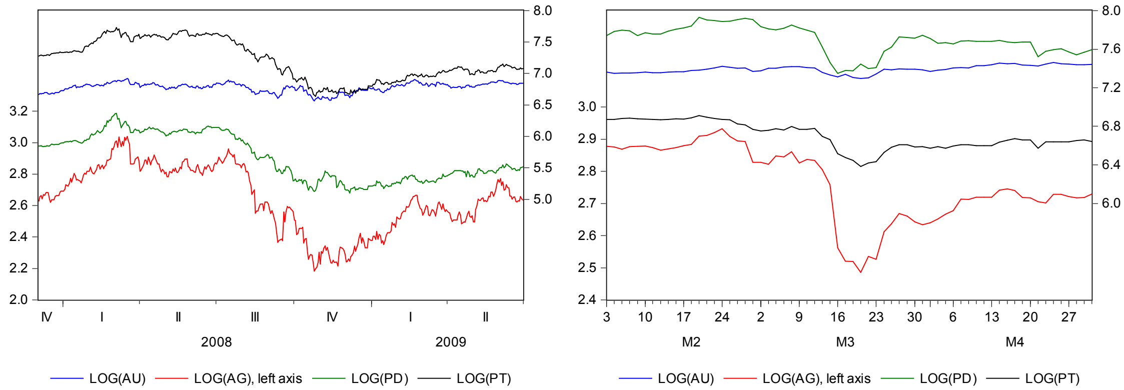
Figure 1 shows the evolution of the four spot prices under examination over the whole period with the NBER dated U.S. recessions in gray color. Not surprisingly, all precious metals exhibit an increasing trend since the early 2000s. Figures 2a and 2b zoom in on the two most recent recessions, namely, the 2007-2009 Global Financial Crisis and the recent Covid-19 shock, respectively. A pattern emerges where all metals but gold take a big blow right at the outset of both recessive periods, and eventually go back to roughly pre-shock levels. Gold, instead, remains unaltered, possibly due to its longer track record as a safe haven asset (see, Sikiru and Salisu, 2021), but also because of its significant market capitalization.

Figure 1. Evolution of the Precious Metal Prices



Note. NBER-dated U.S. recessions are shown in gray color.

Figure 2. How did metals perform in recent recessions?



a. 2007-2009 Global Financial Crisis. - **b. 2020 Covid shock.**

Table 1 reports the main descriptive statistics of the prices used in our empirical analysis. The 2007-2009 Global Financial Crisis seems to the most volatile when we compared with the other three U.S. recessionary periods.

Table 1. Descriptive Statistics of Precious Metal Prices during U.S. Recessions

Variables	N	Mean	St.dev.	Min	Max
Gold					
July 1990-March 1991	195	5.934	0.036	6.025	5.862
March 2001-November 2001	197	5.605	0.031	5.681	5.545
December 2007-June 2009	412	6.779	0.074	6.919	6.566
March 2020-April 2020	64	7.392	0.039	7.460	7.296
Palladium					
July 1990-March 1991	195	4.569	0.122	4.777	4.372
March 2001-November 2001	197	6.239	0.299	6.703	5.752
December 2007-June 2009	412	5.665	0.363	6.366	5.099
March 2020-April 2020	64	7.699	0.145	7.930	7.350
Platinum					
July 1990-March 1991	195	6.068	0.082	6.223	5.937
March 2001-November 2001	197	6.240	0.144	6.442	6.028
December 2007-June 2009	412	7.206	0.320	7.728	6.637
March 2020-April 2020	64	6.699	0.141	6.912	6.385
Silver					
July 1990-March 1991	195	1.464	0.101	1.651	1.266
March 2001-November 2001	197	1.462	0.031	1.535	1.402
December 2007-June 2009	412	2.644	0.206	3.040	2.183
March 2020-April 2020	64	2.759	0.117	2.932	2.485

It is within this context that we now move on to study both the unit roots and potential degree of fractional differentiation. We believe our fractional integration analysis in the following section will throw more light on our previous intuition, namely, that gold stands out among metals as a reliable hedge against financial uncertainty. The results for the Augmented Dickey-Fuller test (ADF) (Dickey and Fuller, 1981) and Phillips-Perron test (PP) (Phillips and Perron, 1988) are reported in Table 2. We provide two specifications of the ADF and PP tests. The first specification included a constant only and the second specification included a constant and a time trend. All four metals are non-stationary I(1), with the possible exception of gold during the 2007-2009 crisis (at 10% significance). This is consistent with our visual analysis in Figure 2 above and the idea that gold remains the asset of reference under financial uncertainty. These results encourage us to take a step further and explore fractional integration in the next section.[3]

[3] Notice that unit root methods have very low power if the data generating process is in fact fractionally integrated. Classical references in this context are Diebold and Rudebusch (1991), Hassler and Wolters (1994), and Lee and Schmidt (1996).

Table 2. Unit Roots Tests during U.S. Recessions

Variable	ADF unit root test		ADF unit root test	
	With constant	With constant and trend	With constant	With constant and trend
Gold				
July 1990-March 1991	-2.292	-2.7897	-2.3316	-2.818
	(0.171)	(0.202)	(0.163)	(0.192)
March 2001-November 2001	-1.971	-2.736	1.905	-2.769
	(0.299)	(0.223)	(0.329)	(0.211)
December 2007-June 2009	**-2.704**	-2.689	**-2.765**	-2.751
	(0.074)	(0.241)	(0.064)	(0.216)
March 2020-April 2020	-1.404	-2.509	-1.679	-2.317
	(0.575)	(0.322)	(0.436)	(0.418)
Palladium				
July 1990-March 1991	-1.544	-1.642	-1.542	-1.807
	(0.508)	(0.772)	(0.509)	(0.697)
March 2001-November 2001	-0.989	-2.880	-0.998	-2.587
	(0.756)	(0.171)	(0.753)	(0.286)
December 2007-June 2009	-0.864	-1.236	-0.913	-1.332
	(0.799)	(0.901)	(0.783)	(0.878)
March 2020-April 2020	-1.920	-2.402	-1.759	-2.229
	(0.321)	(0.375)	(0.397)	(0.465)
Platinum				
July 1990-March 1991	-1.341	-2.654	-1.261	-2.762
	(0.610)	(0.257)	(0.647)	(0.213)
March 2001-November 2001	-1.054	-2.124	-0.951	-1.935
	(0.733)	(0.529)	(0.770)	(0.632)
December 2007-June 2009	-0.745	-1.245	-0.800	-1.311
	(0.833)	(0.899)	(0.817)	(0.884)
March 2020-April 2020	-1.831	-2.503	-1.506	-1.681
	(0.362)	(0.323)	(0.524)	(0.748)
Silver				
July 1990-March 1991	-1.022	-2.408	-0.985	-2.516
	(0.745)	(0.374)	(0.758)	(0.320)
March 2001-November 2001	-2.108	-2.453	-2.026	-2.464
	(0.242)	(0.351)	(0.276)	(0.346)
December 2007-June 2009	-1.451	-1.722	-1.428	-1.702
	(0.558)	(0.739)	(0.569)	(0.749)
March 2020-April 2020	-1.676	-2.315	-1.644	-1.761
	(0.438)	(0.419)	(0.455)	(0.712)

Note: p-values for the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root test statistics are given in parenthesis.

3. Fractional integration on precious metal prices during recessions

Tables 3-6 display the results based on fractional integration. The examined model is

$$y_t = \beta_0 + \beta_1 t + x_t; \qquad (1 - B)^d x_t = u_t, \quad t = 1, 2, \ldots, \qquad (1)$$

where y_t are the observed data; β_0 and β_1 denote the unknown coefficients for an intercept and a linear time trend respectively; B is the backshift operator, i.e., $Bx_t = x_{t-1}$; and u_t is an I(0) or short memory process that is assumed to be a white noise process, in Tables 3 and 4, and weakly autocorrelated (Bloomfield, 1973) in Tables 5 and 6.

Tables 4 and 6 show the estimates of d along with the 95% confidence band of the non-rejection values of d (using Robinson's 1994 testing procedure) corresponding to the three classical cases examined in the unit root literature, namely, (i) a model with no deterministic terms, i.e., imposing β_0 and β_1 equal to zero in Eq. (1), (ii) including only a constant, and (iii) including a constant and a linear time trend. We marked the selected model in bold for each subsample across the tables, it being obtained by means of the t-values of the estimated coefficients in the d-differenced series. Table 3 refers to the case of white noise errors, while Table 5 refers to the autocorrelated model for the error term. Tables 4 and 6 display the estimated coefficients of the selected models.

In Table 3 we observe that the time trend is only significant for palladium during the 2001 recession, the trend coefficient being significantly negative (Table 4). For the rest of the cases, the intercept is sufficient to describe the deterministic terms of the series. Looking at the estimated values of d, it is noticed that all of them are equal to or higher than 1, not finding a single case where mean reversion occurs. Gold is the only metal where the I(1) hypothesis cannot be rejected in any of the four subsamples and this hypothesis is rejected in favor of $d > 1$ in 2001 for palladium; whereas it is rejected for platinum in the 2009 and 2020 recessions; and for silver in the 2020 recession.

Table 3. Results Based on White Noise Errors

Series	No deterministic terms	With only an intercept	With an intercept and a linear trend
Gold			
July 1990-March 1991	0.98 (0.89, 1.10)	**0.96 (0.86, 1.09)**	0.96 (0.86, 1.09)
March 2001-November 2001	0.98 (0.90, 1.10)	**0.92 (0.82, 1.03)**	0.91 (0.82, 1.03)
December 2007-June 2009	0.99 (0.93, 1.07)	**0.97 (0.90, 1.05)**	0.97 (0.90, 1.05)
March 2020-April 2020	0.94 (0.79, 1.17)	**1.09 (0.87, 1.39)**	1.09 (0.87, 1.39)
Palladium			
July 1990-March 1991	0.99 (0.89, 1.10)	**0.98 (0.87, 1.13)**	0.98 (0.87, 1.13)
March 2001-November 2001	0.99 (0.90, 1.10)	1.06 (0.94, 1.21)	**1.06 (0.94, 1.22)**
December 2007-June 2009	1.00 (0.93, 1.07)	**1.04 (0.98, 1.12)**	1.04 (0.98, 1.11)
March 2020-April 2020	0.95 (0.80, 1.18)	**1.21 (1.02, 1.50)**	1.22 (1.02, 1.50
Platinum			
July 1990-March 1991	0.98 (0.89, 1.10)	**0.95 (0.84, 1.10)**	0.95 (0.84, 1.10)
March 2001-November 2001	0.98 (0.89, 1.10)	**1.09 (0.98, 1.25)**	1.09 (0.98, 1.25)
December 2007-June 2009	0.99 (0.93, 1.07)	**1.06 (1.00, 1.13)**	1.06 (1.00, 1.13)
March 2020-April 2020	0.95 (0.79, 1.17)	**1.20 (1.03, 1.42)**	1.20 (1.03, 1.42)
Silver			
July 1990-March 1991	0.98 (0.83, 1.10)	**0.95 (0.86, 1.06)**	0.95 (0.86, 1.06)
March 2001-November 2001	0.97 (0.89, 1.09)	**0.94 (0.86, 1.05)**	0.94 (0.86, 1.05)
December 2007-June 2009	1.00 (0.93, 1.07)	**0.97 (0.91, 1.03)**	0.97 (0.91, 1.03)
March 2020-April 2020	0.95 (0.80, 1.18)	**1.23 (1.04, 1.48)**	1.22 (1.04, 1.48)

Note: In bold, the results for the selected model according to the deterministic terms. In parenthesis, the 95% confidence band for the values of d. In bold, the selected specification.

Table 4. Estimated Coefficients in the Models Reported in Table 3

Series	d (Conf. interval)	Intercept (t-value)	Time trend (t-value)
Gold			
July 1990-March 1991	0.96 (0.86, 1.09)	5.879 (489.86)	---
March 2001-November 2001	0.92 (0.82, 1.03)	5.582 (657.39)	---
December 2007-June 2009	0.97 (0.90, 1.05)	6.669 (363.55)	---
March 2020-April 2020	1.09 (0.87, 1.39)	7.363 (475.30)	---
Palladium			
July 1990-March 1991	0.98 (0.87, 1.13)	4.760 (283.14)	---
March 2001-November 2001	1.06 (0.94, 1.22)	6.679 (277.19)	-0.00409 (-1.77)
December 2007-June 2009	1.04 (0.98, 1.12)	5.849 (196.42)	---
March 2020-April 2020	1.21 (1.02, 1.50	7.732 (157.63)	---
Platinum			
July 1990-March 1991	0.95 (0.84, 1.10)	6.188 (454.52)	---
March 2001-November 2001	1.09 (0.98, 1.25)	6.406 (408.90)	---
December 2007-June 2009	1.06 (1.00, 1.13)	7.278 (295.72)	---
March 2020-April 2020	1.20 (1.03, 1.42)	6.873 (213.39)	---
Silver			
July 1990-March 1991	0.95 (0.86, 1.06)	1.590 (112.38)	---
March 2001-November 2001	0.94 (0.86, 1.05)	1.504 (155.32)	---
December 2007-June 2009	0.97 (0.91, 1.03)	2.630 (89.30)	---
March 2020-April 2020	1.23 (1.04, 1.48)	2.878 (93.52)	---

Note: In parenthesis, the 95% confidence band for the values of d. In bold, the selected specification.

Table 5. Results Based on Autocorrelated Errors

Series	No deterministic terms	With only an intercept	With an intercept and a linear trend
Gold			
July 1990-March 1991	0.94 (0.81, 1.15)	**0.86 (0.72, 1.07)**	0.86 (0.72, 1.07)
March 2001-November 2001	0.96 (0.80, 1.15)	**0.93 (0.76, 1.17)**	0.93 (0.76, 1.17)
December 2007-June 2009	0.98 (0.88, 1.10)	**0.93 (0.82, 1.07)**	0.93 (0.83, 1.07)
March 2020-April 2020	0.85 (0.41, 1.24)	0.71 (0.37, 1.27)	**0.68 (0.33, 1.28)**
Palladium			
July 1990-March 1991	0.98 (0.81, 1.17)	0.80 (0.68, 0.99)	**0.76 (0.62, 0.98)**
March 2001-November 2001	0.96 (0.83, 1.16)	0.85 (0.74, 1.00)	**0.81 (0.60, 0.99)**
December 2007-June 2009	0.99 (0.91, 1.10)	**1.04 (0.96, 1.14)**	1.04 (0.96, 1.14)
March 2020-April 2020	0.83 (0.57, 1.24)	**0.92 (0.52, 1.51)**	0.91 (0.45, 1.51)
Platinum			
July 1990-March 1991	0.96 (0.82, 1.16)	0.79 (0.68, 0.99)	**0.79 (0.64, 0.99)**
March 2001-November 2001	0.97 (0.83, 1.15)	0.88 (0.77, 1.06)	**0.87 (0.75, 1.06)**
December 2007-June 2009	1.02 (0.93, 1.12)	**1.04 (0.97, 1.15)**	1.04 (0.97, 1.15)
March 2020-April 2020	0.93 (0.67, 1.32)	**1.29 (0.88, 2.31)**	1.28 (0.85, 2.33)
Silver			
July 1990-March 1991	0.94 (0.80, 1.14)	**0.97 (0.81, 1.18)**	0.97 (0.81, 1.18)
March 2001-November 2001	0.96 (0.81, 1.16)	**1.02 (0.85, 1.26)**	1.02 (0.85, 1.26)
December 2007-June 2009	0.99 (0.88, 1.10)	**1.03 (0.94, 1.17)**	1.03 (0.94, 1.17)
March 2020-April 2020	1.00 (0.57, 1.25)	**1.10 (0.70, 1.74)**	1.10 (0.70, 1.74)

Note: In bold, the results for the selected model according to the deterministic terms. In parenthesis, the 95% confidence band for the values of d. In bold, the selected specification.

Table 6. Estimated Coefficients in the Models Reported in Table 5

Series	d (Conf. interval)	Intercept (t-value)	Time trend (t-value)
Gold			
July 1990-March 1991	0.86 (0.72, 1.07)	5.881 (500.00)	---
March 2001-November 2001	0.93 (0.76, 1.17)	5.582 (656.50)	---
December 2007-June 2009	0.93 (0.82, 1.07)	6.670 (365.14)	---
March 2020-April 2020	0.68 (0.33, 1.28)	7.355 (525.07)	0.00132 (2.17)
Palladium			
July 1990-March 1991	0.76 (0.62, 0.98)	4.763 (303.96)	-0.00158 (-4.21)
March 2001-November 2001	0.81 (0.60, 0.99)	6.678 (2909.14)	-0.00449 (-6.64)
December 2007-June 2009	1.04 (0.96, 1.14)	5.849 (196.43)	---
March 2020-April 2020	0.92 (0.52, 1.51)	7.744 (156.30)	---
Platinum			
July 1990-March 1991	0.79 (0.64, 0.99)	6.190 (475.33)	-0.00116 (-3.28)
March 2001-November 2001	0.87 (0.75, 1.06)	6.402 (417.91)	-0.00167 (-2.84)
December 2007-June 2009	1.04 (0.97, 1.15)	7.278 (295.34)	---
March 2020-April 2020	1.29 (0.88, 2.31)	6.873 (217.93)	---
Silver			
July 1990-March 1991	0.97 (0.81, 1.18)	1.590 (112.34)	---
March 2001-November 2001	1.02 (0.85, 1.26)	1.506 (155.26)	---
December 2007-June 2009	1.03 (0.94, 1.17)	2.628 (89.42)	---
March 2020-April 2020	1.10 (0.70, 1.74)	2.878 (91.65)	---

Note: In parenthesis, the 95% confidence band for the values of d. In bold, the selected specification.

Tables 5 and 6 exhibit the case of autocorrelation, where we observe that the time trend is required in a number of cases: during the 2020 recession for gold, and in 1990-1991 and 2001 for palladium and platinum. Surprisingly, the time trend is significantly positive in the last recession (Covid-19) for gold but negative in the four remaining cases for palladium and platinum. Regarding the degree of persistence, the I(1) hypothesis cannot be rejected in any of the four subsamples for gold; for the remaining cases, however, the values of d are smaller than in the previous case for white noise errors, and even for a few cases, a small degree of mean reversion is detected for palladium (1990-1991 and 2001) and for platinum (1990-1991).

The persistence in gold prices under the autocorrelated model during the Covid-19 shock presents the lowest value (d = 0.68) compared with the three previous recessions (0.86, 0.93 and 0.93) and also shows the lowest value compared with other three precious metals (i.e., 0.92 for palladium, 1.29 for platinum, and 1.10 for silver). The estimated degree of persistence suggests that gold prices are mean reverting faster than other precious metals during the Covid-19 pandemic (see Sikiru and Salisu, 2021).

4. Final remarks

Precious metal prices are relevant variables in both financial and commodity markets. However, very limited empirical evidence is available concerning their behavior in recessions. The present study fills this gap by examining precious metal prices in U.S. recessions using a fractional integration framework which is more general than the standard approach based on the I(0)/I(1) dichotomy. Our empirical analysis shows the unrelenting prominence of gold in relation to other precious metals as a hedge against market uncertainty in post-pandemic new era. Indeed, gold still enjoys support and popularity beyond the barbarous relic sobriquet, as revealed both by our empirical analyses.

Future research should focus on the interplay with other assets, most prominently cryptocurrency market, that might challenge, or else complement, gold's financial status quo as a store of value during crises and recessions.

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