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Global Crises and Gold as a Safe Haven: Evidence from Over Seven and a Half Centuries of Data

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Abstract

Using annual data spanning the period of 1258-2018, we test the safe haven characteristic of gold in the wake of global crises. We find that, when we allow for regime-switching to capture nonlinearity and structural breaks, gold serves as a strong hedge against crises, especially during the bullish regime of the market, and in particular from the post-World War I period, as suggested by a time-varying model. In comparison, silver, however, does not seem to possess the safe haven property over the historical period of 1688-2018. Finally, we also find that global crises can accurately predict real gold returns over a long-span (1302-2018) out-of-sample period.

JEL Codes: C22, Q02
Keywords: Global Crises, Gold, Safe Haven, Regime-Switching Model.

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1. Introduction

There exists a large literature that has looked into the "safe haven" status of gold relative to stock, bond and currency markets (see for example, Baur and Lucey (2010), Baur and McDermott (2010), Reboredo (2013a), Agyei-Ampomah et al., (2014), Gürgün and Ünalmis (2014), Beckmann et al., (2015)), as well as oil prices (Reboredo, 2013b; Tiwari et al., 2019). More recently, studies have also analyzed the role of economic uncertainty and geopolitical risks, i.e., non-financial indicators, as drivers of gold prices in the context of its safe haven property (see for example, Baur and Smales (2018), Bouoiyour et al., (2018), Beckmann et al., (2019)).

We aim to build along the latter line of research, by analysing, for the first time, the impact of global crises on (real) gold returns spanning over seven and a half centuries of annual data (1257-2018) using a regime (Markov)-switching model. This approach allows us to test for the safe haven hypothesis of gold in the wake of global crises by controlling for misspecification due to uncaptured nonlinearity, and detects for which regime(s), i.e., bear and/or bull, gold returns increase due to crises over the historical period considered. Unlike the existing studies analysing the safe haven property of gold relying on data post-World War II, we cover the longest possible evolution history of the gold market. In doing so, we avoid any sample selection bias.

The remainder of the paper is organized as follows: Section 2 describes the data, methodology and results, while Section 3 presents additional analyses and Section 4 concludes the paper.

2. Data, Methodology and Results

We use annual data for nominal prices (in British pounds) of gold over 1257 to 2018 retrieved from Measuring Worth.[1] The nominal price of gold was transformed into its real counterpart by deflating with the Consumer Price Index (CPI) derived from a database maintained by the Bank of England called "A Millenium of Macroeconomic Data for the UK".[2] We then compute the log-returns of real gold prices, which is plotted in Figure A1 and summarized in Table A1, both of which are included in the Appendix of the paper. As can be seen from Table A1, real gold return (*rgr*) depicts positive skewness and excess kurtosis, and hence is non-normal, as derived from the strong rejection of the null of normality under the Jarque-Bera test. This provides an initial motivation to look at a regimes-based model. As far as the dates of global crises is concerned, we rely on the information available in Galbraith (1990), Reinhart and Reinhart (2010), and Reihart and Rogoff (2009, 2011), with data beyond 2010 derived from the list of major economic crises available online.[3] Table A2 in the Appendix of the paper tabulates the crises. We define a dummy variable, *D*, which takes the value of one for the dates of crises and zero otherwise.[4]

We start our analysis by estimating a linear regression model of *rgr*, on *D* and two lags of *rgr* as suggested by the Schwarz Information Criterion (SIC).[5] Using Newey and West (1987) heteroskedasticity and autocorrelation corrected (HAC) standard errors, the coefficient on the dummy was 2.8953 with a *p*-value of 0.0548. In other words, we found weak (at the 10% level of significance) evidence of gold serving as a safe haven in the wake of global crises. Realizing the

[1] The data is downloadable from: https://www.measuringworth.com/datasets/gold/.

[2] The complete data set is available for download from: https://www.bankofengland.co.uk/statistics/research-datasets.

[3] See: https://en.wikipedia.org/wiki/List_of_economic_crises.

[4] Note that, we intentionally leave out the years of the two World Wars from the list, so that these years do not serve as outliers driving our results, and in the process, we concentrate on pure economic and financial crises associated with the extreme behaviour of the general macroeconomic variables and financial markets. However, our results are qualitatively similar if the dummy variable takes a value of one instead of zero for the years associate with the two wars. Complete details of these results are available upon request from the authors.

[5] We experimented with lagged values of *D*, but the model fit deteriorated, with lags of *D* being insignificant. Complete details of these results are available upon request from the authors.

long sample involved in our analysis, we use the Bai and Perron (2003) tests of multiple structural breaks, and detected as many as 5 breaks at 1302, 1340, 1377, 1817 and 1981. We then applied the Brock et al., (1996, BDS) test of nonlinearity on the residuals recovered from the linear regression. As seen from Table A3 in the Appendix, the null of *i.i.d.* is overwhelmingly rejected at the highest level of significance across all dimensions of the test considered, and hence, indicates uncaptured nonlinearity. Given the existence of regimes changes and nonlinearity, it is understandable that the linear model is misspecified, and hence the results derived from it cannot be relied upon. So we next turn our attention to the following Markov-switching model:

$$rgr_t = \alpha_{0,St} + \alpha_{1,S_t} rgr_{t-1} + \alpha_{2,S_t} rgr_{t-2} + \alpha_{3,S_t} D_t + \varepsilon_t \qquad (1)$$

where $\varepsilon_t \sim iid(0, \sigma^2_{S_t})$ and S_t is a discrete unobservable regime variable taking the values of 1 and 2. The transition between the regime is governed by the first-order Markov process, which means that S_t depend only on the previous regime S_{t-1} as denoted below:

$$p_{ij} = pr(S_t = i / S_{t-1} = j), i, j \in \{1, 2\}.$$

The value p_{ij} is known as the transition probability of moving to state i at t from state j at $t-1$, and is assumed to be independent of time. The transition probabilities must satisfy the condition that $\sum_i p_{ij} = 1$, for all j.

The result from the Markov-Switching model is presented in Table 1. As can be seen gold serves as a safe haven in both regimes with a positive coefficient corresponding to D_t, but the effect is strongly statistically significant at the 1% level in the bull-regime, i.e., Regime 1. Note the effect of crises on gold returns is only significant at the 10% level in the bear-regime, i.e., Regime 1. The smoothed probabilities of Regime 2, as plotted in Figure 1, tends to suggest that the safe haven result is primarily driven by the occurrence of the bull market towards the beginning and end of the sample period.[6] In sum, our results tend to suggest that while gold does act as a safe haven when a crisis occurs, it does so more strongly during the bull-phases of the market.[7] In the process, we also highlight the importance of undertaking a nonlinear approach.

[INSERT TABLE 1 AND FIGURE 1]

3. Additional Analyses

In this section, we conduct four additional analyses. First, realizing that the frequency of crises is limited to only one for the period of 1258-1599, we re-estimated our Markov-Switching model over the period of 1600-2018. As reported in Table A4, our results of Table 1 continue to hold with gold serving as a strong safe haven in the bull-regime. Second, we conducted a forecasting exercise, whereby we estimated the model in equation (1) with and without *D*, and forecasted one-year-ahead in a recursive fashion over the out-of-sample period of 1302-2018 (with an in-sample of 1258-1301), given that the first breakpoint is at 1302. The root mean squared error (RMSE) for the unrestricted (i.e., the model with crises) and restricted (without *D*) models, was found to be 8.4923 and 8.5657 respectively. In other words, information on global crises also had significant

[6] The probability of staying in the bull regime, given that the gold market was in the same regime the year before was found to be highly persistent at 94.89%, with an expected duration of about 19.56 years.

[7] Our result is robust to the usage of nominal gold returns. As a corollary to our analysis of safe haven, when we estimated time-varying persistence of gold returns using the method outlined in Boubaker (2018), we found that persistence was significantly reduced by the crises, which is likely to be an indication of the higher trading in the gold market during episodes of global stress. Complete details of these results are available upon request from the authors.

value[8] in terms of forecasting of real gold returns. Third, though we know that on average gold strongly acts as a safe haven during the bullish market (dates of which we have exactly identified based on the smoothed regime probabilities), we next use a time-varying model relating *rgr* and D, estimated using the Kalman filter in a state-space framework (Durbin and Koopman, 2012), to analyze the evolution of gold as a safe haven over our historical sample period. As can be seen from the time-varying coefficient corresponding to D plotted in Figure A2, the effect is predominantly positive with statistical significance observed from the early 1920s (1923 to be exact at the 5% level, and 1918 at the 10% level). This result tends to suggest that gold has been a safe haven primarily, i.e., in the statistical sense, since the end of World War I. Finally, to make our case stronger in favour of gold's unique safe haven characteristic, we also estimated a regime-switching model for the real returns on silver (*rsr*) over the period of 1688-2018, with the start date being contingent on data availability of silver prices.[9] Unlike gold, as seen from Table A5, global crises is found to negatively affect real silver returns, though the effect is statistically insignificant.

4. Conclusion

In this paper, we use the longest possible annual data available on gold prices over the period of 1257 to 2018, and test for its safe haven property by analysing the impact of global crises. Using a linear model, we find gold only acts as a weak safe haven, but since we detect nonlinearity and structural breaks, the linear model is misspecified. Next, when we rely on a regime-switching model, we find that gold serves as a strong hedge against risks associated during episodes of crises, especially when the gold market is in a bullish-phase, and in particular from the post-World War I period, as suggested by a time-varying model. In addition, information content of the global crises variable is also found to predict gold returns accurately over a long-span out-of-sample period. In comparison, based on historical data over the period of 1687 to 2018, silver does not seem to possess the safe haven property. Our paper thus, provides overwhelming support of gold being a safe haven relative to global crises, by tracking the longest possible historical evolution of this market possible.

[8] McCraken's (2007) *MSE-F* statistic of forecast comparison across nested models produced a corresponding value of 12.2354, which was significant at the 1% level of significance.
[9] As with gold, nominal silver prices in British pounds were also derived from Measuring Worth, and converted to real values by deflating with the CPI.

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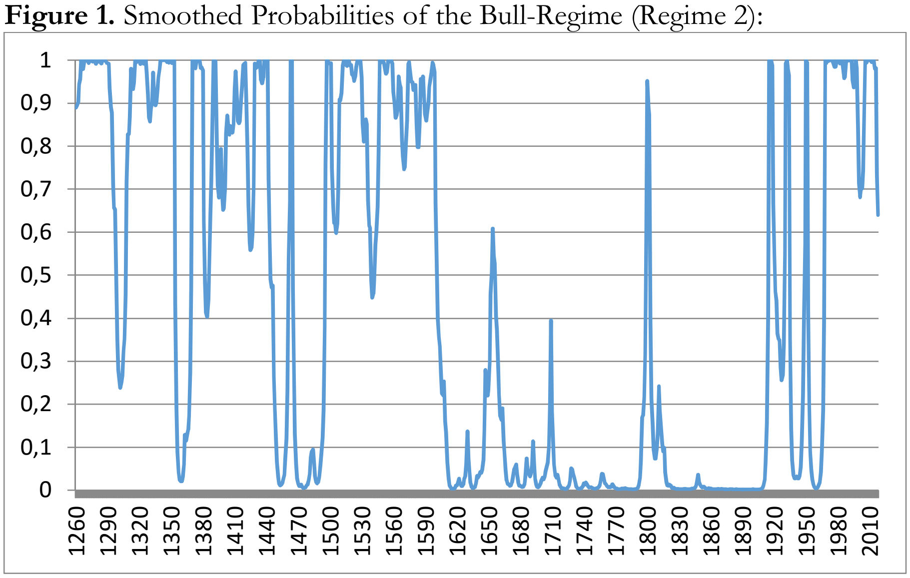
Table 1. Markov-Switching Model Estimates for Real Gold Returns (1258-2018)

Coefficient	Estimate	Std. Error	z-Statistic	Prob.
		Regime 1		
α_{01}	-0.4216	0.2563	-1.6448	0.1000
α_{31}	1.0872	0.6468	1.6809	0.0928
α_{11}	0.1833	0.0542	3.3837	0.0007
α_{21}	-0.2297	0.0474	-4.8469	0.0000
$\log(\sigma_1)$	1.4786	0.0514	28.7745	0.0000
		Regime 2		
α_{02}	-0.3058	0.7182	-0.4258	0.6702
α_{32}	5.4254	2.0315	2.6706	0.0076
α_{12}	0.1223	0.0555	2.2030	0.0276
α_{22}	-0.2107	0.0573	-3.6770	0.0002
$\log(\sigma_2)$	2.4800	0.0542	45.7280	0.0000
		Transition Matrix Parameters		
$p_{0,11}$	3.1316	0.4246	7.3762	0.0000
$p_{0,21}$	-2.9210	0.5448	-5.3617	0.0000

Mean *rgr*	0.020206	S.D. *rgr*	8.929976
S.E. of regression	8.652950	SSR	56080.28
Durbin-Watson stat	2.027459	Log likelihood	-2597.270
AIC	6.875546	SIC	6.948779

Note: Estimates correspond to: $rgr_t = \alpha_{0,st} + \alpha_{1,s_t} rgr_{t-1} + \alpha_{2,s_t} rgr_{t-2} + \alpha_{3,s_t} D_t + \varepsilon_t$, where *rgr* is real gold log-returns.

Figure 1. Smoothed Probabilities of the Bull-Regime (Regime 2):



APPENDIX:

Table A1. Summary Statistics

Statistic	*rgr*
Mean	0.0267
Median	-0.3983
Maximum	44.7947
Minimum	-28.4885
Std. Dev.	8.9191
Skewness	0.6113
Kurtosis	6.0658
Jarque-Bera	345.4142
p-value	0.0000
Observations	761

Note: *rgr*: real gold log-returns; Std. Dev.: Standard deviation; *p*-value: probability of the Jarque-Bera test with the null of normality.

Table A2. List of Global Crises

Crises	Date
14th century banking crisis	1345
The century Kipper und Wipper financial crisis	1618–1622
Tulip mania bubble	1637
The General Crisis	1640
Great Tobacco Depression	1703
South Sea Bubble	1720
Mississippi Company	1720
Crisis of 1763	1763
Great East Indian Bengal Bubble Crash	1769
Crisis of 1772	1772
War of American Independence Financing Crisis	1776
Panic of 1785	1785
Panic of 1792	1792
Panic of 1796–1797	1796–1797
Danish state bankruptcy	1813
Post-Napoleonic depression	1815
Panic of 1819	1819
Panic of 1825	1825
Panic of 1837	1837
Panic of 1847	1847
Panic of 1857	1857
Panic of 1866	1866
Great Depression of British Agriculture	1873–1896
Long Depression	1873–1896

Panic of 1901	1901
Panic of 1907	1907
Depression of 1920-21	1920-1921
Wall Street Crash of 1929 and Great Depression	1929–1939
OPEC oil price shock	1973
Energy crisis	1979
Secondary banking crisis	1973–1975
Early 1980s Recession	1981-1982
Latin American debt crisis	1982
Bank stock crisis	1983
Japanese asset price bubble	1986–1992
Black Monday	1987
Savings and loan crisis	1986–1995
Special Period in Cuba	1990–1994
India economic crisis	1991
Finnish banking crisis	1991-1993
Swedish banking crisis	1990
Economic crisis in Mexico	1994
Asian financial crisis	1997
Russian financial crisis	1998
Ecuador financial crisis	1998-1999
Argentine economic crisis	1999–2002
Samba effect	1999
Dot-com bubble	2000-2002
Turkish economic crisis	2001
Uruguay banking crisis	2002
Venezuelan general strike	2002–2003
Financial Crisis	2007-2009
2000s energy crisis	2003-2009
Subprime mortgage crisis	2007-2010
United States housing bubble and United States housing market correction	2003-2011
Automotive industry crisis	2008–2010
Icelandic financial crisis	2008–2012
Irish banking crisis	2008–2010
Russian financial crisis	2008–2009
Latvian financial crisis	2008
Venezuelan banking crisis	2009–2010
Spanish financial crisis	2008-2016
European sovereign debt crisis	2009-2018, and ongoing
Portuguese financial crisis	2010-2014
Crisis in Venezuela	2012-2018, and ongoing

Ukrainian crisis	2013-2014
Russian financial crisis	2014
Brazilian economic crisis	2014-2017
Chinese stock market crash	2015
Turkish currency and debt crisis	2018
Debt crisis in India	1993-2018, and ongoing

Sources: Galbraith (1990), Reinhart and Reinhart (2010), and Reihart and Rogoff (2009, 2011), with data beyond 2010 derived from the list of major economic crises available online at: https://en.wikipedia.org/wiki/List_of_economic_crises.

Table A3. Brock et al., (1996, BDS) Test of Nonlinearity

Independent Variable	Dimension				
	2	3	4	5	6
rgr	8.089194***	10.15849***	11.32392***	12.67988***	13.74119***

Note: Entries correspond to the *z*-statistic of the BDS test with the null of *i.i.d.* residuals, with the test applied to the residuals recovered from the real gold returns (*rgr*) equation with two lags of gold returns and the contemporaneous crises dummy; * indicates rejection of the null hypothesis at 1 percent level of significance.

Table A4. Markov-Switching Model Estimates for Real Gold Returns (1600-2018)

Coefficient	Estimate	Std. Error	*z*-Statistic	Prob.
Regime 1				
α_{01}	-0.4872	0.2686	-1.8134	0.0698
α_{31}	1.2527	0.6310	1.9852	0.0471
α_{11}	0.2305	0.0527	4.3758	0.0000
α_{21}	-0.1969	0.0502	-3.9267	0.0001
$\log(\sigma_1)$	1.4680	0.0456	32.1727	0.0000
Regime 2				
α_{02}	-1.3736	3.0619	-0.4486	0.6537
α_{32}	5.4103	4.2160	1.2833	0.1994
α_{12}	0.4356	0.1262	3.4508	0.0006
α_{22}	-0.2981	0.1339	-2.2257	0.0260
$\log(\sigma_2)$	2.7522	0.0994	27.6852	0.0000
Transition Matrix Parameters				
$p_{0,11}$	3.7404	0.4925	7.5944	0.0000
$p_{0,21}$	-1.9560	0.5215	-3.7506	0.0002

Mean *rgr*	0.081765	S.D. *rgr*	8.178857
S.E. of regression	7.527664	SSR	23176.28
Durbin-Watson stat	1.948417	Log likelihood	-1330.120
AIC	6.406302	SIC	6.521945

Note: Estimates correspond to: $rgr_t = \alpha_{0,St} + \alpha_{1,S_t} rgr_{t-1} + \alpha_{2,S_t} rgr_{t-2} + \alpha_{3,S_t} D_t + \varepsilon_t$, where *rgr* is real gold log-returns.

Table A5. Markov-Switching Model Estimates for Real Silver Returns (1688-2018)

Coefficient	Estimate	Std. Error	*z*-Statistic	Prob.
		Regime 1		
α_{01}	-0.5752	0.3802	-1.5130	0.1303
α_{31}	-0.2166	1.0228	-0.2118	0.8323
α_{11}	0.2048	0.0608	3.3661	0.0008
α_{21}	-0.3101	0.0595	-5.2143	0.0000
$\log(\sigma_1)$	1.6159	0.0699	23.1174	0.0000
		Regime 2		
α_{02}	0.2781	3.2128	0.0866	0.9310
α_{32}	-0.6952	4.3598	-0.1595	0.8733
α_{12}	0.1352	0.1027	1.3162	0.1881
α_{22}	-0.2357	0.1028	-2.2918	0.0219
$\log(\sigma_2)$	3.0339	0.0819	37.0398	0.0000
		Transition Matrix Parameters		
$p_{0,11}$	4.6655	0.8564	5.4478	0.0000
$p_{0,21}$	-3.9169	0.9149	-4.2811	0.0000
Mean *rsr*	-0.426462	S.D. *rsr*		12.53536
S.E. of regression	12.21342	SSR		47584.46
Durbin-Watson stat	2.019815	Log likelihood		-1149.971
AIC	7.063653	SIC		7.202111

Note: Estimates correspond to: $rsr_t = \alpha_{0,st} + \alpha_{1,S_t} rsr_{t-1} + \alpha_{2,S_t} rsr_{t-2} + \alpha_{3,S_t} D_t + \varepsilon_t$, where *rsr* is real silver log-returns.

Figure A1. Data Plot of Real Gold Log-Returns

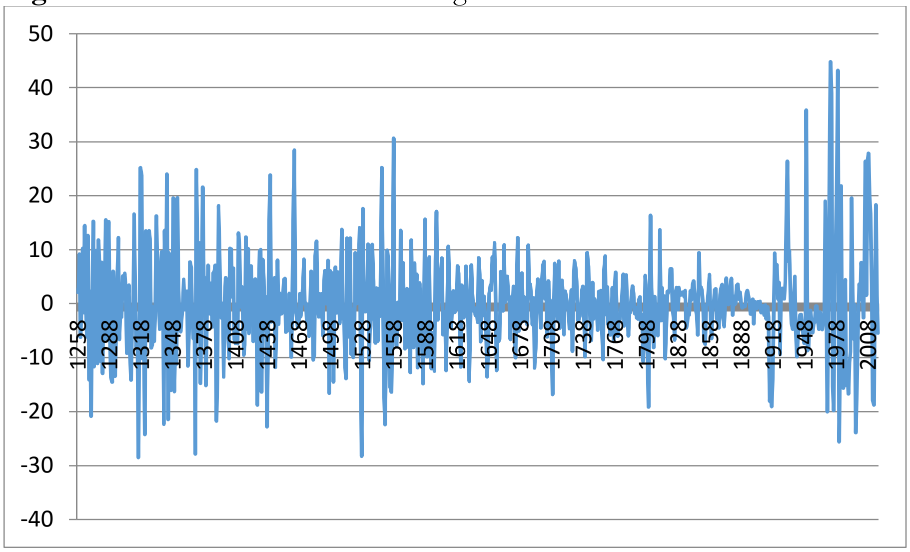
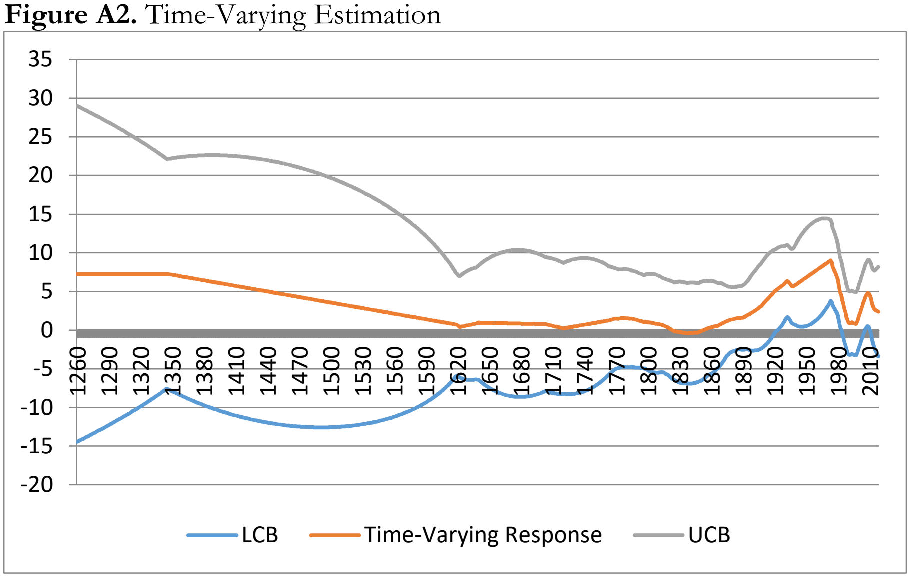


Figure A2. Time-Varying Estimation



Note: LCB and UCB are upper and lower confidence bands respectively for the time varying response of real gold returns to crises.