Gold and Geopolitical Risk

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Abstract

There is a growing empirical literature on gold's safe haven status with respect to financial risks but no study with respect to global geopolitical risks. This paper extends the common focus on extreme stock market movements and financial turmoil with an analysis of geopolitical risk. We find that gold shows a unique behavior among all precious metals with a positive reaction to geopolitical risks and threats but no reaction to realized geopolitical acts. There is no additional increase in gold return volatility due to geopolitical risks and geopolitical risk is not captured by the stock market volatility index VIX. The findings provide new evidence on the unique status of gold as a global safe haven asset.

Keywords: Gold; safe haven; geopolitical risks; VIX; precious metals; Bitcoin

JEL: G10; G11; G14: G15; G18; F5

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1. Introduction

Geopolitical news appears to influence financial markets. The decision to leave the European Union ("Brexit") in June 2016, the US election of Donald Trump in November 2016 and the North Korea "nuclear crisis" in 2017 are more recent examples of political news with geopolitical repercussions and significant stock market reactions. Hence, it is useful for investors to know if there is an asset that is immune to such shocks or even hedges such shocks by increasing in value. Given gold's status as a safe haven asset in general and against financial turmoil in particular we hypothesize that it is also a hedge against global geopolitical risks.

The analysis of geopolitical risks fills a gap in the growing empirical literature on safe haven assets and gold as most studies focus on gold's safe haven status against financial variables such as changes in stock market indices (e.g. Baur and McDermott, 2010 and Gürgün and Ünalmis), bond market indices (e.g. Baur and Lucey, 2010 and Agyei-Ampomah et al., 2014), exchange rates (e.g. Reboredo, 2013a) and oil prices (e.g. Reboredo, 2013b). In contrast, studies that analyze non-financial indicators are rare (e.g. Beckmann et al., 2017 investigate the impact of economic uncertainty).

In addition, the majority of studies is on gold (e.g. Baur and Lucey, 2010) and there are not many studies on all four precious metals (see Li and Lucey, 2017).

This paper contributes to the literature as it is the first study to analyze changes in both perceived and realized global geopolitical risk on changes in the price of gold, silver, palladium, platinum, copper, the S&P500 and Bitcoin. The global nature and non-financial characteristic of the risk measure used in this study are both important and distinguishing features with respect to existing studies that predominantly use local or regional financial risk factors.

The main findings can be summarized as follows. First, gold is positively related to changes in geopolitical risk and displays a unique behavior, i.e. all other assets analyzed do not show a positive relationship with geopolitical risks. Second, the geopolitical risk factor is different to financial market uncertainty as proxied by the VIX. Third, only

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perceived geopolitical risks matter for the price of gold whilst realized geopolitical risks do not display any significant relationship with changes in the price of gold. Fourth, geopolitical risks increase the price of gold but not the volatility of gold. Fifth, the price of Bitcoin is not related to geopolitical risks and hence does not share the safe haven properties with gold.

The remainder of this paper is structured as follows: Section 2 describes the data used for the empirical analysis in Section 3 followed by Section 4 which summarizes the main findings and provides concluding remarks.

2. Data

Geopolitical Risk Index

The key measure of geopolitical risk utilised in this study is the Geopolitical Risk (GPR) Index of Caldara and Iacoviello (2017). They define geopolitical risk as the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations. This characterisation captures both the risk that these events materialize, and the risks associated with an escalation of existing events. Covering the period January 1985 to November 2017, the GPR Index is constructed on a monthly basis using automated text-searches of the incidence of words related to geopolitical tensions in 11 leading international newspapers[1]. The index reflects, in each month, the proportion of news articles discussing geopolitical risk, normalized to a value of 100 in the 2000-09 decade. A reading of 200 would then indicate that newspaper mentions of rising geopolitical risk in that month were twice as frequent as the average during the 2000s.

[1] The 11 newspapers include: The Boston Globe, Chicago Tribune, The Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, Los Angeles Times, The New York Times, The Times, The Wall Street Journal, and the Washington Post.

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The automated search[2] identifies articles containing references to six groups of words: Group 1 includes words associated with explicit mentions of geopolitical risk, as well as mention of military-related tensions involving large regions of the world and a U.S. involvement. Group 2 includes words directly related to nuclear tensions. Groups 3 and 4 include mention of war threats and terrorist threats, respectively. Lastly, groups 5 and 6 capture press coverage of actual adverse geopolitical events (as opposed to just risks) which can be reasonably expected to lead to increases in geopolitical uncertainty, such as terrorist acts or the start of a war.

The direct effect of adverse geopolitical events is further disentangled from the effect of pure geopolitical risks by construction of two sub-indexes. The Geopolitical Threats (GPT) index only includes words belonging to groups 1 to 4, while the Geopolitical Acts (GPA) index only includes words belonging to groups 5 and 6. GPT therefore captures the possibility of geopolitical action, whereas GPA captures the actuality of a geopolitical event.

< Insert Figure 1 >

The GPR Index is plotted in Figure 1. The GPR Index reached its high point of 536.22 in March 2003, as the U.S. invaded Iraq. The index also has several large spikes which become more frequent towards the end of the sample period. The most notable spikes occur in April 1986 (U.S. bombing Libya), January 1991 (1st Gulf War), September 2001 (9/11 terror attacks), March 2003 (2nd Gulf War), August 2014 (Russia-Ukraine crisis), and November 2015 (Paris terror attacks). During the course of our analysis we define periods of high (low) geopolitical risk that occur when the GPR Index is in the top (bottom) quintile, above 102.96 (below 43.66).

[2] Further detailed information, including audit details, and data download can be obtained via Matteo Iacoviello's website: https://www2.bc.edu/matteo-iacoviello/gpr.htm#overview

Market Returns

The primary focus of this study is to understand the response of precious metal prices to changes in geopolitical risk. Thus, we source a set of monthly[3] prices from DataStream for *Gold*, *Silver*, *Platinum* and *Palladium* and compute a set of monthly log returns[4]. For comparative purposes, we also consider a purely industrial metal (*Copper*) and a widely used stock index (*SP500*). Precious metals are priced in U.S. $ per troy ounce, while Copper is priced in U.S. $ per metric tonne. The evolution of market prices is illustrated in Figure 2, with periods of high (top quintile) geopolitical risk indicated.

< Insert Figure 2 >

Summary statistics for monthly market returns, together with monthly changes in GPR Index (*ΔGPR*) are presented in Table 1. During the sample period, palladium has the largest monthly return among precious metals (0.56%) and also has the greatest price volatility. For all metals, the largest monthly decline occurred in the aftermath of the Lehman collapse in September 2008 (while stock markets had large declines in the same period, the SP500 suffered an even larger fall in October 1987). There is also evidence that the distribution of monthly returns is leptokurtic ("fat tails" prevalent across financial assets). In general, the monthly returns exhibit negative skewness, with gold returns providing the sole case of positive skewness.

< Insert Table 1 >

[3] Monthly prices are used in order to correspond with the availability of the GPR Index data – that our results are robust at this data frequency serves to emphasise the strength of the identified relationship.

[4] While the results presented in this paper use prices for bullion / physical metals we have also repeated the analysis with futures prices and achieve qualitatively similar results.

Macroeconomic Control Variables

We also utilise a number of well-established macroeconomic control variables to control for the state of the economy and reflect economic risk. The *credit spread* is defined as the spread between yields on bonds rated Aaa and Baa by Moody's. The *term premium* is the difference between yields on 2-year and 10-year U.S. Treasury bonds. Lastly, *Industrial Production* is used as a gauge of economic output.

3. Empirical Analysis

Methodology

We investigate the impact of changes in geopolitical risk on precious metals and other assets using the following ordinary least squares (OLS) regression specification:

$$R_t = \beta_0 + \beta_1 \Delta GPR_t + \varepsilon_t \qquad (1.A)$$

$$R_t = \beta_0 + \beta_1 \Delta GPR_t + \beta_2 M_t + \varepsilon_t \quad (1.B)$$

Where R_t denotes the monthly return of the particular metal (*Gold, Silver, Platinum, Palladium, Copper*) or an alternative asset during month *t*. The key explanatory variable for this study is ΔGPR_t, the change in the geopolitical risk index during month *t*. M_t is a vector of control variables that includes the monthly changes in the credit spread (Δ*Credit Spread*), term premium (Δ*Term Premium*) and industrial production (Δ*Ind. Prod*.) during the corresponding month *t*. ε_t are Newey-West standard errors with lags optimised by AIC.

We use a simple specification assuming that the relationship between the return of an asset and changes in geopolitical risks is stable for different levels of geopolitical risk and different changes of geopolitical risk. We do not distinguish between a hedge and a safe haven as proposed by Baur and Lucey (2010) and Baur and McDermott (2010) as geopolitical risk is not a financial risk measure. We explicitly test the assumptions regarding the stability of the relationship in the robustness section below.

Effect of Geopolitical Risk on Precious Metals Returns

Estimated regression coefficients for our baseline model (Eq. 1.A and 1.B) are shown in Table 2. The identified relationship is positive and highly significant for gold; that is, increases (decreases) in geopolitical risk are associated with increases (declines) in the gold price. A one standard deviation change in GPR results in a 0.80% gold price return (42.153 * 0.019). This result is contrary to that identified for the other precious metals where the sign of the coefficient is negative and statistically insignificant and consistent with gold's role as a safe haven during times of heightened geopolitical risk. The findings are also consistent with Batten et al. (2010) who demonstrate that precious metals are "too distinct to be considered a single asset class".

< Insert Table 2 >

For comparative purposes, we also consider the effect of change in geopolitical risk on copper (whose price is closely linked to economic growth via capital investment) and the S&P 500 Index. Ex-ante, we would expect that higher geopolitical risk should be associated with negative returns in both markets as capital investment is likely to fall, and investors will be less likely to own risky assets. This expectation aligns with our reported results, and (for the S&P500) corresponds with the results of Caldara and Iacoviello (2017).

Precious metal returns, along with those of copper and stocks, are negatively related to changes in the credit spread at the 1% level (with the exception of gold which has a negative but insignificant relationship). This is because wider credit spreads are indicative of tighter monetary conditions, whereby financing of assets and leverage is more expensive, particularly where the asset is not cash-flow generative (as in the case of metals). While the term premium has a negative relationship with stock returns it does not have a well-defined relationship with any of the metals. Lastly, industrial production is positively associated with copper returns which aligns with the familiar use of copper as a leading indicator of economic growth.

The results for Bitcoin (which are not reported in detail due to space considerations) show a comparatively large and positive response to an increase in geopolitical risks but the coefficient estimates are statistically insignificant. This similarity to the reaction of gold is not surprising given that both assets share key features such as a constrained supply, costly mining, decentralization, independence of any government and global and continuous trading. The insignificance of the coefficient estimates can be explained with the extreme volatility of Bitcoin.

Effect of Perceived Risk versus Geopolitical Events

In the next stage of our analysis, we utilise the sub-indexes of Caldara and Iacoviello (2017) to examine the effect of *perceived* geopolitical risk as opposed to *actual* geopolitical events. We augment our baseline OLS specification as follows:

$$R_t = \beta_0 + \beta_1 \Delta GPR\ Threat_t + \beta_2 \Delta GPR\ Acts_t + \varepsilon_t \qquad (2.A)$$

$$R_t = \beta_0 + \beta_1 \Delta GPR\ Threat_t + \beta_2 \Delta GPR\ Acts_t + \beta_3 M_t + \varepsilon_t \quad (2.B)$$

Essentially, the specification is the same as in the prior model apart from the disaggregation of changes in geopolitical risk (Δ*GPR Index*) into geopolitical threats (Δ*GPR Threat*) and geopolitical acts (Δ*GPR Acts*). That is, GPR Threat uses only articles directly mentioning geopolitical risks, while GPR Acts measure uses only articles mentioning actual events. The estimated coefficients are reported in Table 3.

< Insert Table 3 >

The disaggregation shows that positive gold returns are primarily driven by increases in geopolitical threat (Δ*GPR Threat*) rather than actual geopolitical events (Δ*GPR Acts*). Indeed, the occurrence of geopolitical events seems to be related to negative gold returns. Perhaps an example of the old adage of "buying the rumour and selling the fact". Disaggregated geopolitical risks do not have any well-defined effect on the other precious metals, and are only weakly negatively

associated (10% level) with copper and stock returns. The reported coefficients for control variables are consistent with those reported earlier, whereby credit spreads are negatively associated with returns in general, the term premium is negatively associated with stock returns, and industrial production is positively associated with copper returns.

Is the effect consistent across all states?

For investors wishing to utilise this safe haven property of gold to protect against changes in geopolitical risk it is relevant to discover whether the effect is consistent across all states, or concentrated in particular times of geopolitical stress. We investigate this property by repeating our earlier analysis with the sample disaggregated into periods of high and low geopolitical risk. We assign an observation to a period of high risk if it occurs when GPR is in the top quintile (greater than 102.96), and to a period of low risk if GPR is in the bottom quintile (less than 43.66). The estimated results are reported in Table 4.

< Insert Table 4 >

The well-defined positive relationship previously identified for gold, and the negative relationship identified for stocks, is concentrated during periods of high geopolitical risk (Panel A). There is a positive but insignificant relationship between ΔGPR and gold returns during periods of low geopolitical risk. Indeed, the overall explanatory power of our regression model is very low during periods of low geopolitical risk, as demonstrated by an insignificant *F*-statistic. Changes in geopolitical risk do not explain variation in the majority of precious metals (silver, platinum, or palladium) in either high or low risk eras.

Robustness

Alternate GPR Index Classification

It is desirable to gauge whether our results are tied to the specific classification of geopolitical risk words utilised in the GPR Index. We make a step in testing this via the application of two

additional indexes stipulated by Caldara and Iacoviello (2017). *GPR Broad* is an index that includes words often associated with true positives (e.g. "military presence" or "international terror"), while *GPR Narrow* excludes words associated with false positives (e.g. "death penalty" or "supreme court").

< Insert Table 5 >

The results, reported in Table 5, show that the positive relationship between gold returns and changes in geopolitical risk is consistent across GPR Index measures (the same can be said for SP500 returns). The returns for other precious metals do not respond to any of the GPR measures.

Alternate Measures of Market Uncertainty

It is possible that the measure of geopolitical risk utilised in this study (GPR) is picking up information about financial market uncertainty that is already available via other omitted variables. Caldara and Iacoviello (2017) demonstrate that GPR provides explanatory power in addition to the economic policy uncertainty (EPU) index of Baker et al. (2016). A measure that is commonly used in the literature to explain financial market uncertainty is the Chicago Board Options Exchange Volatility Index (*VIX*). Several studies, notably Whaley (2000), have demonstrated a negative relationship between daily stock returns and VIX (i.e. VIX increases as stock prices fall).

< Insert Table 6 >

We incorporate monthly changes in VIX (ΔVIX) into our specification[5] so as to understand whether ΔGPR provides explanatory power for returns in addition to that given by the popular sentiment measure. Table 6 shows the estimated results. Even after including ΔVIX we find that

[5] CBOE introduced VIX in 1993 and provide back-dated data for this measure to Q1:1988. Therefore, the sample size is reduced by 58 observations as compared to our earlier analysis.

ΔGPR provides statistically significant explanatory power for gold (and stock) returns. This could be due to GPR capturing events that are more likely to be unrelated to the events in financial markets, or to the general business cycle. It is also interesting to note that while the literature has confirmed a clear relationship between *ΔVIX* and stock returns at the daily level, this does not appear to hold at the monthly level. In contrast, *ΔGPR* does seem to provide some explanation for stock returns even at the monthly frequency.

Sub-sample Analysis

Table 7 presents the estimation results for gold based on 10-year sub-samples (Panel A) and 5-year sub-samples (Panel B). The sub-samples reveal that the relationship between gold price changes and changes in geopolitical risk are consistently positive in all periods and even strengthened throughout the sample period. Whilst the 10-year sample coefficient estimates of *ΔGPR* are always statistically significant, this is not the case for the 5-year sample coefficients.

< Insert Table 7 >

One of the periods that are not statistically significant is the 2005 – 2010 sub-sample which contains the Lehman Brothers bankruptcy and the GFC. It is possible that this period was dominated by financial risks and not by geopolitical risks. Additional estimations further restricting the sample period to the GFC and including the VIX confirms this hypothesis and shows that gold price changes were positively affected by geopolitical risks and the VIX but the effect is only statistically significant for the VIX.

Large changes of GPR

Table 8 presents the estimation results for a model that focusses on the top quintile of changes in GPR and shows that the impact of geopolitical risk is qualitatively similar for large changes and average changes as reported above. Table 8 also includes a specification with 1-month lagged

changes of GPR and reveals slightly larger coefficients for all assets except for the S&P500. The adjusted R-squares are also larger for the lagged specification.

< Insert Table 8 >

Effect of Geopolitical Risk on Precious Metals Volatility

The analysis presented above focussed on return effects of geopolitical risks but has not analysed if geopolitical risks also affect the volatility of assets. In this section we summarize additional estimations of model 1.A with an EGARCH variance equation and changes in geopolitical risks included in both the mean equation and the variance equation. The results for gold show no additional effect of geopolitical risk in the variance equation but an increase of volatility due to changes in geopolitical risks for the other precious metals and the S&P500. The effect on the stock market is consistent with the implication of the theoretical model on political news by Pastor and Veronesi (2013). The results for copper imply a decrease in volatility due to increased geopolitical risks. These findings indicate that gold is not only distinctively different from a return perspective but also from a variance perspective as geopolitical risks do not increase the risk of gold but the risk of all the other assets (except copper) in the sample.

4. Summary and Concluding Remarks

This paper provides empirical evidence that gold returns are positively related to changes in geopolitical risk and that its behaviour is unique among a set of alternative assets. More specifically, none of the other precious metals share this property and neither does copper, the S&P500 or Bitcoin. This evidence supports the idea that gold acts as a safe haven in response to increased geopolitical risk. Our results are robust to different classifications of geopolitical risk, and to the inclusion of a widely-used sentiment measure.

Finally, this paper provides new evidence for the unique safe haven status of gold and also broadens the financial perspective using a non-financial and global geopolitical risk measure.

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Figure 1: Geopolitical Risk

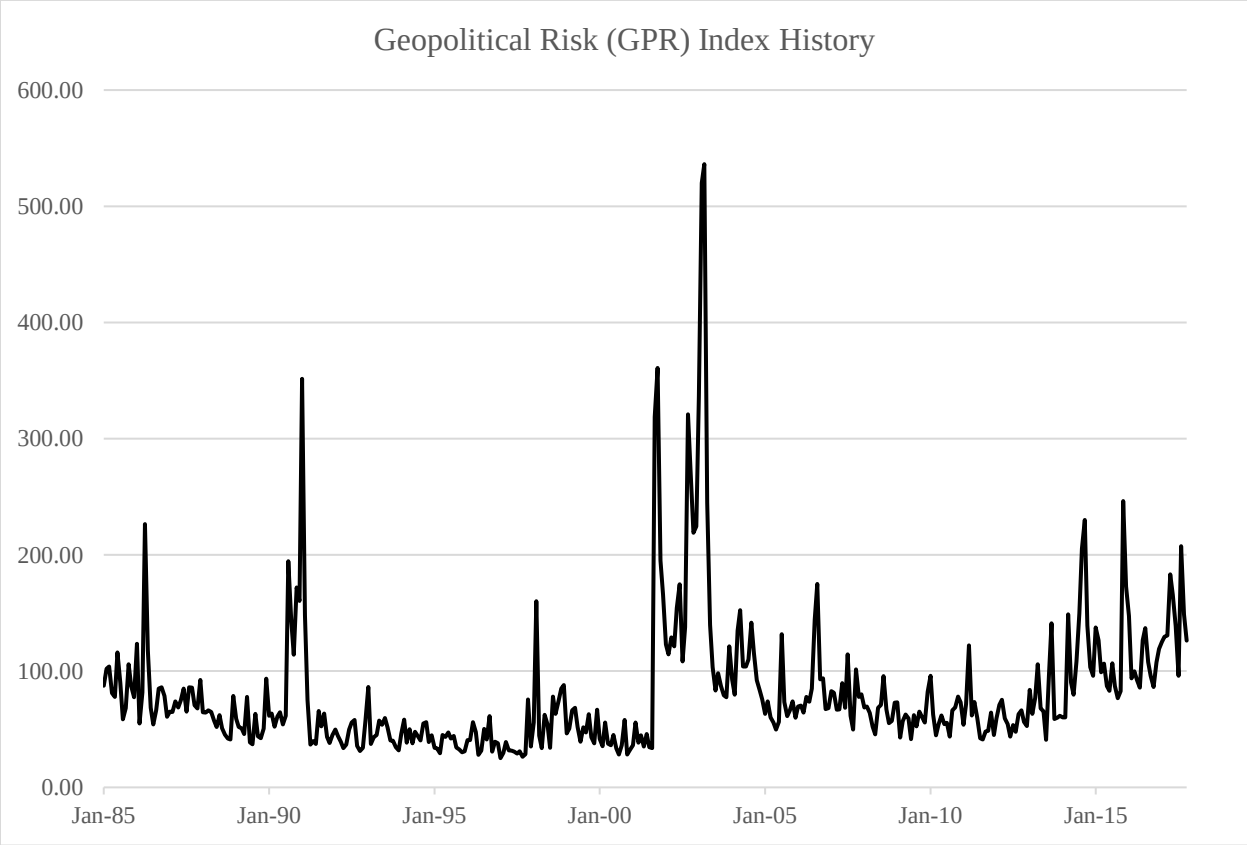

Figure 2: High Geopolitical Risk, Metals and the S&P500

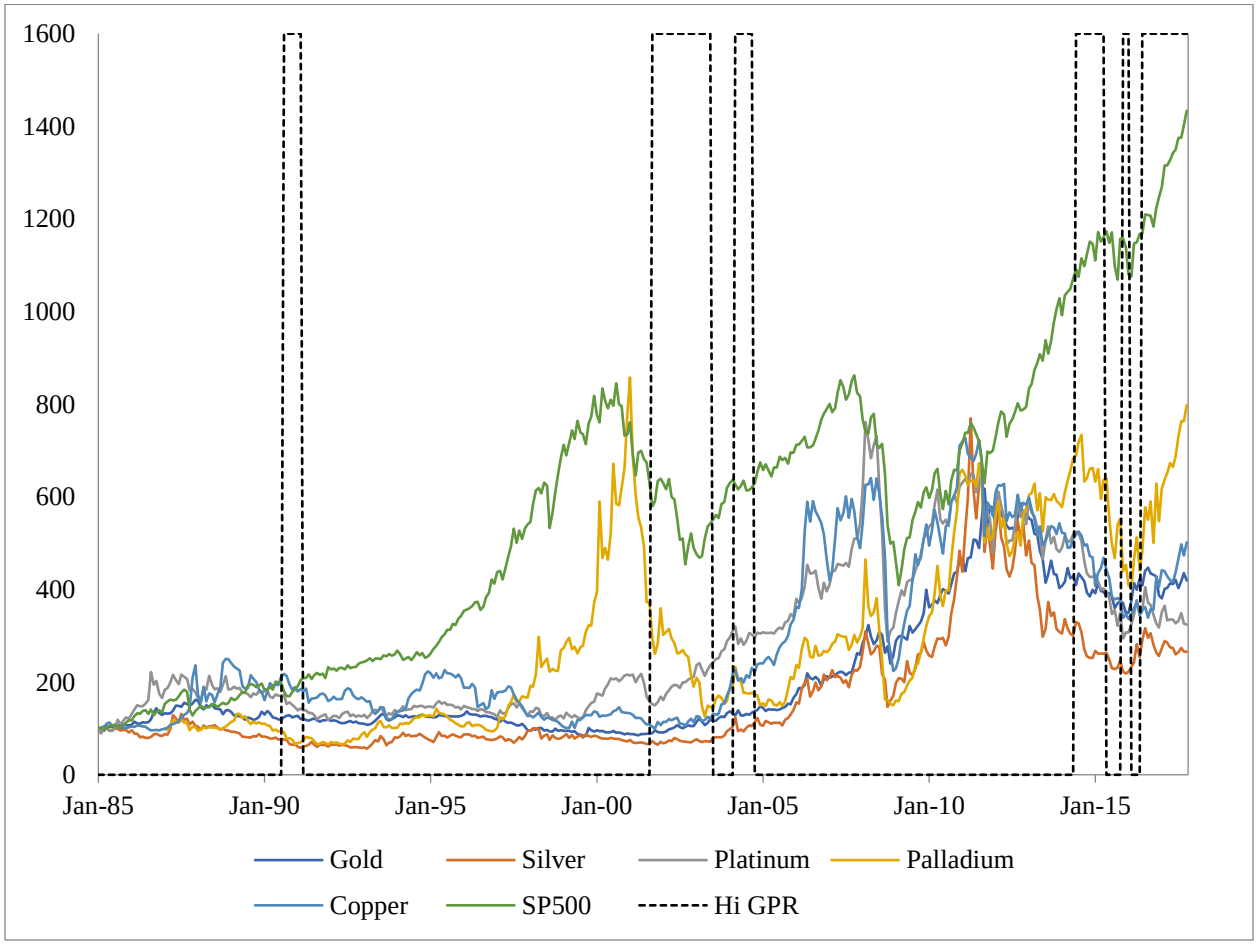

Table 1

Summary Statistics

	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis	Unit Root	
ΔGPR	0.099	42.153	-291.338	284.837	0.407	18.481	-14.357	*
Gold	0.359	4.391	-18.613	16.526	0.023	4.189	-21.894	*
Silver	0.250	7.865	-33.401	25.360	-0.280	4.835	-21.839	*
Platinum	0.291	6.501	-38.737	31.711	-0.450	7.627	-19.517	*
Palladium	0.563	9.454	-41.712	39.994	-0.158	5.791	-19.344	*
Copper	0.417	7.699	-44.319	36.483	-0.376	8.031	-17.661	*
SP500	0.687	4.324	-24.543	12.378	-1.096	6.842	-18.626	*

Note: This table presents summary data for the variables of interest utilised in this study. This includes monthly changes in the geopolitical risk (*GPR*) index in addition to monthly returns for a set of precious metals (*gold, silver, platinum, palladium*), an industrial metal (*copper*) and a stock index (*SP500*). Unit root tests are conducted using Augmented Dickey Fuller with trend and intercept; * indicates rejection of the null of a unit root at the 1% level.
Sample Period: January 1985 - November 2017

Table 2

Regression: Relationship Between Geopolitical Risk (GPR) and Returns

	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	0.361	0.299	0.249	0.327	0.300	0.210	0.565	0.241	0.412	0.238	0.679 ***	0.720 ***
	(0.196)	(0.227)	(0.350)	(0.335)	(0.337)	(0.335)	(0.525)	(0.497)	(0.443)	(0.351)	(0.225)	(0.210)
ΔGPR	0.020 ***	0.019 ***	0.002	-0.001	-0.004	-0.008	-0.014	-0.019	-0.010 *	-0.015 **	-0.014 ***	-0.017 ***
	(0.004)	(0.004)	(0.007)	(0.006)	(0.008)	(0.008)	(0.015)	(0.015)	(0.006)	(0.006)	(0.005)	(0.006)
ΔCredit Spread		-2.302		-14.656 ***		-18.103 ***		-21.424 ***		-18.544 ***		-14.281 ***
		(2.269)		(3.851)		(6.167)		(4.611)		(3.756)		(2.044)
ΔTerm Premium		1.282		0.432		-1.793		1.193		-0.407		-2.936 **
		(1.980)		(3.002)		(3.707)		(3.467)		(2.159)		(1.186)
ΔInd. Prod.		0.480		-0.731		0.548		2.233		1.218 ***		-0.472
		(0.348)		(0.584)		(0.646)		(1.527)		(0.457)		(0.471)
Adj. *R2*	0.033	0.033	0.000	0.027	0.002	0.079	0.001	0.078	0.001	0.066	0.017	0.131
F-Statistic	14.441	4.383	0.031	3.746	0.205	9.460	1.332	8.015	1.225	7.957	7.624	15.782
DW Statistic	2.205	2.193	2.195	2.268	1.968	2.123	2.032	2.171	1.770	1.979	1.894	1.949
No. Obs.	394	394	394	394	394	394	370	370	394	394	394	394

Note: This table presents the coefficients estimated using Eq. (1.A) and Eq. (1.B) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The key explanatory variable is the change in the geopolitical risk index (*ΔGPR*). The set of macroeconomic control variables includes *ΔCredit Spread* (the monthly change in the difference in yields on bonds rated Aaa and Baa by Moody's), *ΔTerm Premium* (the monthly change in the difference in yields on 2-year and 10-year Treasury securities), and *ΔInd. Prod.* (the monthly change in U.S. industrial production). Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1985 - November 2017

Table 3

Regression: Assessing the Importance of Perceived Risk (Threats) Against Actual Events

	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	0.360	0.308	0.249	0.329	0.299	0.219	0.559	0.262	0.412	0.237	0.679 ***	0.725 ***
	(0.196)	(0.198)	(0.350)	(0.329)	(0.337)	(0.337)	(0.550)	(0.482)	(0.449)	(0.359)	(0.226)	(0.216)
ΔGPR Threat	0.021 ***	0.020 ***	0.000	0.000	0.001	-0.001	0.003	-0.002	-0.009	-0.013 *	-0.010 *	-0.010 *
	(0.003)	(0.003)	(0.006)	(0.006)	(0.009)	(0.008)	(0.017)	(0.017)	(0.007)	(0.006)	(0.006)	(0.006)
ΔGPR Acts	-0.003	-0.003	0.001	-0.002	-0.006	-0.008 *	-0.024	-0.025	0.000	-0.002	-0.004	-0.007 *
	(0.002)	(0.002)	(0.006)	(0.006)	(0.005)	(0.004)	(0.018)	(0.110)	(0.006)	(0.005)	(0.003)	(0.003)
ΔCredit Spread		-2.552		-14.739 ***		-18.382 ***		-22.111 ***		-18.535 ***		-14.452 ***
		(3.529)		(3.762)		(6.213)		(4.481)		(4.312)		(1.934)
ΔTerm Premium		1.205		0.422		-1.876		0.895		-0.399		-2.983 **
		(2.160)		(3.894)		(3.736)		(3.741)		(1.993)		(1.301)
ΔInd. Prod.		0.405		-0.746		0.471		2.015 *		1.227 ***		-0.515
		(0.357)		(0.793)		(0.655)		(1.084)		(0.472)		(0.535)
Adj. *R2*	0.004	0.037	-0.005	0.025	-0.002	0.081	0.010	0.080	-0.002	0.064	0.015	0.132
F-Statistic	8.544	4.006	0.011	3.004	0.538	7.897	2.772	7.387	0.626	6.356	4.010	12.939
DW Statistic	2.203	2.194	2.194	2.269	1.976	2.133	2.063	2.202	1.769	1.980	1.891	1.940
No. Obs.	394	394	394	394	394	394	370	370	394	394	394	394

Note: This table presents the coefficients estimated using Eq. (2.A) and Eq. (2.B) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The key explanatory variables are the changes in the geopolitical risk index for threats (*ΔGPR Threat*) and actual events (*ΔGPR Acts*). The set of macroeconomic control variables includes *ΔCredit Spread* (the monthly change in the difference in yields on bonds rated Aaa and Baa by Moody's), *ΔTerm Premium* (the monthly change in the difference in yields on 2-year and 10-year Treasury securities), and *ΔInd. Prod.* (the monthly change in U.S. industrial production). Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1985 - November 2017

Table 4

Regression: Disaggregating the GPR-Return Relationship Into Periods of High and Low Risk

Panel A: Hi GPR	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	0.375	0.402	-0.183	-0.164	-0.019	-0.010	-1.165	-1.163	0.203	0.195	0.794 *	0.834
	(0.407)	(0.079)	(0.716)	(0.134)	(0.587)	(0.367)	(44.820)	(1.826)	(0.570)	(3.931)	(0.453)	(12.710)
ΔGPR	0.018 ***	0.015 ***	0.003	0.001	-0.003	-0.005	-0.011	-0.013	-0.013 *	-0.014	-0.019 ***	-0.018
	(0.004)	(0.001)	(0.005)	(0.002)	(0.009)	(0.004)	(0.623)	(0.020)	(0.007)	(0.022)	(0.005)	(0.085)
ΔCredit Spread		-5.742 ***		-3.606 *		-5.030 *		-18.814 ***		-1.200		-3.236
		(0.946)		(1.810)		(2.886)		(5.797)		(13.548)		(11.598)
ΔTerm Premium		4.827 ***		3.471 ***		1.299		-3.224		3.999		-6.205
		(1.606)		(0.808)		(1.272)		(9.367)		(32.749)		(56.082)
ΔInd. Prod.		1.069 **		0.734 *		0.565		0.596		0.974 *		-1.417
		(0.481)		(0.385)		(1.140)		(1.520)		(0.534)		(0.851)
Adj. *R2*	0.105	0.115	-0.012	-0.046	-0.011	-0.042	-0.006	-0.0242	0.020	0.066	0.155	0.176
F-Statistic	9.040	3.539	0.067	0.139	0.178	0.199	0.576	0.574	2.614	7.957	15.257	5.185
DW Statistic	2.357	2.461	2.062	2.079	2.272	2.296	2.335	2.3644	2.589	1.979	1.898	1.890
No. Obs.	79	79	79	79	79	79	73	73	79	79	79	79

Panel B: Lo GPR	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	-0.186	-0.142	0.374 ***	-0.071	0.510	0.338	2.029	1.192	-0.439	0.320	0.940 ***	1.160 **
	(0.360)	(0.567)	(0.084)	(0.734)	(0.337)	(0.798)	(1.227)	(1.278)	(1.122)	(0.747)	(0.030)	(0.536)
ΔGPR	0.038	0.042	-0.004 ***	-0.019	-0.006	-0.011	0.010	-0.012	-0.041	-0.020	0.053 ***	0.061 *
	(0.036)	(0.038)	(0.001)	(0.051)	(0.002)	(0.043)	(0.076)	(0.045)	(0.060)	(0.043)	(0.032)	(0.033)
ΔCredit Spread		-7.829		21.296 **		14.939 *		13.771		5.128		-14.216 **
		(9.619)		(10.233)		(7.961)		(12.352)		(5.791)		(6.902)
ΔTerm Premium		-3.128		4.007		-1.975		0.789		-8.890 ***		-2.179
		(2.004)		(3.532)		(2.928)		(3.887)		(2.005)		(2.873)
ΔInd. Prod.		0.102		1.072		0.323		2.805 *		-2.832 **		-0.428
		(1.932)		(1.440)		(1.704)		(1.579)		(1.319)		(1.160)
Adj. *R2*	0.000	-0.013	-0.013	0.012	-0.013	0.001	-0.013	-0.0295	-0.008	0.006	0.014	0.030
F-Statistic	1.034	0.756	0.007	1.240	0.018	1.105	0.012	0.4396	0.368	1.125	2.140	1.599
DW Statistic	1.800	1.752	2.198	2.086	2.041	2.031	1.877	1.751	2.034	2.234	2.198	2.440
No. Obs.	79	79	79	79	79	79	78	78	79	79	79	79

Note: This table presents the coefficients estimated using Eq. (1.A) and Eq. (1.B) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The key explanatory variable is the change in the geopolitical risk index (*ΔGPR*). The set of macroeconomic control variables includes *ΔCredit Spread* (the monthly change in the difference in yields on bonds rated Aaa and Baa by Moody's), *ΔTerm Premium* (the monthly change in the difference in yields on 2-year and 10-year Treasury securities), and *ΔInd. Prod.* (the monthly change in U.S. industrial production). Panel A reports the estimated coefficients when the level of GPR is in the highest quintile (> 102.96) and Panel B reports the estimated coefficients when the level of GPR is in the lowest quintile (< 43.66). Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1985 - November 2017

Table 5

Robustness: Confirming the GPR-Return Relationship for Narrow and Broad Measures

	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	0.360 *	0.363 *	0.248	0.249	0.299	0.299	0.565	0.562	0.412	0.410	0.679 ***	0.677 ***
	(0.196)	(0.196)	(0.350)	(0.356)	(0.337)	(0.336)	(0.526)	(0.527)	(0.442)	(0.445)	(0.225)	(0.225)
ΔGPR Narrow	0.018 ***		0.003		-0.002		-0.009		-0.009		-0.013 **	
	(0.003)		(0.007)		(0.008)		(0.014)		(0.006)		(0.005)	
ΔGPR Broad		0.026 ***		0.000		-0.010		-0.023		-0.025 ***		-0.023 ***
		(0.006)		(0.012)		(0.011)		(0.023)		(0.009)		(0.008)
Adj. *R2*	0.029	0.027	-0.002	-0.003	-0.002	-0.001	-0.001	0.002	0.000	0.006	0.017	0.022
F-Statistic	12.598	11.751	0.091	0.000	0.055	0.768	0.690	1.703	0.962	3.458	7.624	9.674
DW Statistic	2.209	2.210	2.196	2.194	1.968	1.969	2.029	2.037	1.771	1.761	1.894	1.887
No. Obs.	394	394	394	394	394	394	370	370	394	394	394	394

Note: This table presents the coefficients estimated using Eq. (1.A) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The explanatory variables are the change in the narrow (*ΔGPR Narrow*) and broad (*ΔGPR Broad*) geopolitical risk index. Newey-West standard errors are reported in parantheses.
***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.
Sample Period: January 1985 - November 2017

Table 6

Robustness: Introducing a Common Measure of Market Uncertainty

	Gold		Silver		Platinum		Palladium		Copper		SP500		
Constant	0.290	0.292	0.208	0.209	0.183	0.183	0.504	0.504	0.383	0.382	0.567 **	0.566	***
	(0.215)	(0.215)	(0.385)	(0.394)	(0.363)	(0.362)	(0.564)	(0.567)	(0.496)	(0.506)	(0.255)	(0.258)	
ΔGPR	0.024 ***		0.005		0.001		-0.011		-0.010		-0.016 ***		
	(0.004)		(0.007)		(0.007)		(0.015)		(0.006)		(0.006)		
ΔVIX	0.052	0.053	0.021	0.021	0.105	0.105	0.065	0.065	0.139	0.138	0.040	0.039	
	(0.076)	(0.074)	(0.098)	(0.099)	(0.085)	(0.083)	(0.111)	(0.112)	(0.131)	(0.135)	(0.047)	(0.043)	
Adj. *R2*	0.047	0.000	-0.005	-0.003	-0.001	0.002	-0.003	-0.002	0.002	0.002	0.019	-0.002	
F-Statistic	9.170	0.853	0.123	0.041	0.868	1.731	0.532	0.281	1.292	1.684	4.213	0.453	
DW Statistic	2.221	2.213	2.185	2.183	1.833	1.832	1.963	1.954	1.762	1.771	1.866	1.834	
No. Obs.	336	336	336	336	336	336	336	336	336	336	336	336	

Note: This table presents the coefficients estimated using Eq. (1.A) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The explanatory variables are the change in the geopolitical risk index (*ΔGPR*) and changes in the CBOE implied volatility index (*ΔVIX*). Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1988 - November 2017

Table 7

Robustness: Consistency of Gold Return - Δ*GPR* Relationship Over Time

Panel A: 10-Yr Intervals	1985 - 1995		1995 - 2005		2005 - 2015		2015 - 2017	
Constant	0.185		0.108		0.779	*	0.672	*
	(0.294)		(0.269)		(0.457)		(0.387)	
ΔGPR	0.014	*	0.017	***	0.047	***	0.031	***
	(0.007)		(0.004)		(0.014)		(0.010)	
Adj. *R2*	0.013		0.060		0.051		0.030	
F-Statistic	2.507		8.593		7.386		5.791	
DW Statistic	2.188		2.266		2.217		2.188	
No. Obs.	120		120		120		155	

Panel B: 5-Yr Intervals	1985 - 1990		1990 - 1995		1995 - 2000		2000 - 2005		2005 - 2010		2010 - 2015		2010 - 2017	
Constant	0.438		-0.095		-0.449		0.668	**	1.457	**	-0.047		0.076	
	(0.461)		(0.388)		(0.378)		(0.331)		(0.642)		(0.605)		(0.463)	
ΔGPR	0.008		0.018	**	0.010		0.018	***	0.017		0.065	***	0.035	**
	(0.015)		(0.007)		(0.016)		(0.005)		(0.019)		(0.016)		(0.011)	
Adj. *R2*	-0.013		0.036		-0.011		0.112		-0.011		0.129		0.053	
F-Statistic	0.234		3.248		0.321		8.605		0.357		9.900		6.213	
DW Statistic	2.162		2.236		2.224		2.432		2.225		2.184		2.157	
No. Obs.	60		60		60		60		60		60		95	

Note: This table presents the coefficients estimated using Eq. (1.A) where the dependent variable is the monthly return on gold for various sample periods. The explanatory variable is the monthly change in the geopolitical risk index (*ΔGPR*). Panel A reports estimated coefficients for the sample partitioned into 10-year intervals, while Panel B reports results for 5-year intervals. Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1985 - November 2017

Table 8

Periods of large changes in GPR

	Gold		Silver		Platinum		Palladium		Copper		SP500	
Constant	0.667 ***	1.268 ***	-0.530	-1.205	-0.066	-1.189	0.268	-1.982	0.336	-1.462	1.845 **	0.110
	(0.220)	(0.103)	(1.478)	(0.904)	(0.939)	(0.824)	(1.764)	(1.188)	(0.999)	(0.666)	(0.670)	(0.560)
ΔGPR	0.015 ***		0.001		-0.010		-0.034		-0.014		-0.027 **	
	(0.004)		(0.019)		(0.014)		(0.027)		(0.012)		(0.011)	
ΔGPR(-1)		0.020 ***		-0.006		-0.001		-0.005		-0.015 *		-0.022 ***
		(0.002)		(0.009)		(0.008)		(0.015)		(0.008)		(0.006)
Adj. *R2*	0.018	0.032	-0.012	-0.009	-0.007	-0.013	-0.011	-0.013	-0.003	0.012	0.073	0.095
F-Statistic	2.400	3.556	0.002	0.282	0.481	0.012	1.845	0.0826	0.781	1.930	7.228	9.315
DW Statistic	2.471	2.357	2.619	2.391	1.325	1.015	1.868	1.958	0.948	1.352	1.106	1.253
No. Obs.	80	80	80	80	80	80	80	80	80	80	80	80

Note: This table presents the coefficients estimated using Eq. (1.A) where the dependent variable is the monthly return on a precious metal (*gold, silver, platinum, palladium*), an industrial metal (*copper*) or a stock market index (*SP500*). The explanatory variables are (concurrent and lagged) monthly changes in the geopolitical risk index (*ΔGPR*). The table reports the estimated coefficients when the monthly change in GPR is in the highest quintile (> 14.83). Newey-West standard errors are reported in parantheses.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level respectively.

Sample Period: January 1985 - November 2017