The Timing of the Flight to Gold: An Intra-day Analysis of Gold and the S&P500[☆]

Dirk G. Baur[a], Konstantin Kuck[b,*]

[a] *UWA Business School, 35 Stirling Highway, Crawley, Perth, WA6018, Australia.*
[b] *University of Hohenheim, Department of Econometrics and Statistics, Schloss Hohenheim 1 C, 70593 Stuttgart, Germany*

Abstract

We use high-frequency intra-day gold and S&P500 data covering the period from 2007 to 2018 to investigate when and how fast gold prices react to extreme negative shocks in the equity market. Our empirical analysis reveals three new features of gold: First, extreme negative 5-min S&P500 returns lead to a positive reaction of the gold price. Second, on days with extreme price declines in the stock market, gold continues to increase post US stock trading hours. Third, daily extreme negative equity returns accrue comparatively slowly over several hours. The findings show that there is a fast reaction of gold prices to extreme negative stock returns consistent with a "flight" to gold.

JEL Classification: D81; F30; G01; G11; G14

Keywords: Gold, safe haven, intra-day data, high-frequency

[☆] We are indebted to Robert Jung and Karsten Schweikert for many valuable comments and suggestions on earlier versions of the manuscript. We further thank all participants of the "Brown Bag Seminar in Finance" at the University of Hohenheim in summer 2017 as well as the participants of the "15th INFINITI Conference on International Finance", held at the University of Valéncia and the "12th International Conference for Computational and Financial Econometrics, held at the University of Pisa. *This version:* 2019-04-19.

[*] Corresponding author. Tel.: +49 711 459 24717
Email address: konstantin.kuck@uni-hohenheim.de (Konstantin Kuck)

1. Introduction

The role of gold as a safe haven asset is well established since the work by Baur and Lucey (2010) and Baur and McDermott (2010). Although the safe haven property of gold has been assessed relative to different asset markets and currencies, there is no study that analyses the safe haven effect of gold at the intra-day level.[1] In other words, it is not clear when and how fast investors react to large negative shocks in the stock market over short time horizons with purchases of gold, that is, a "flight to gold".[2]

This paper aims to fill this gap in the literature. We use high-frequency intra-day returns of the S&P500 and gold spot and futures, sampled at 5-min intervals, and study how the prices of those two assets evolve over the trading day on average and in the presence of extreme losses in the equity market. Our sample spans the 11-year period from 2007 until 2018 covering episodes of sustained uncertainty (e.g. the Global Financial Crisis as well as the (Eurozone) sovereign debt crisis) associated with strongly declining equity prices. Hence, the dataset is well suited for the analysis of the safe haven effect of gold from an intra-day perspective. Since the gold futures market might be more liquid than gold spot prices, we analyze the dynamic relationships with the S&P500 for both types of gold.

The remainder of this paper contains an Empirical Analysis (Section 2) which presents our dataset and provides a descriptive analysis of extreme events and an analysis of the average response of gold to large stock market shocks. The paper concludes with a summary of the main findings and their implications (Section 3).

2. Empirical Analysis

2.1. Data

We use intra-daily prices for the S&P500, gold spot and futures sampled at the 5-min frequency, covering the period from January 03, 2007 until July 13, 2018. All time series have been downloaded from

[1] Ranaldo and Söderlind (2010) analyze the safe haven property of major currencies using intra-day data and Batten et al. (2017) study general statistical patterns of intra-day precious metals returns.

[2] A "flight to gold" implies portfolio re-balancing and a *strong safe haven effect* (negative correlation of gold price changes with equity price changes in extreme market conditions. In contrast, a *weak safe haven effect* (zero correlation) does not automatically imply a "flight to gold" since it is also possible that investors do not buy gold and re-balance their portfolios but simply do not sell their gold holdings when all other assets (asset classes) suffer extreme losses.

Thomson Reuters Tick History (DataScope).[3] Regarding the futures prices, we focus on the front contract, as common in the literature.

Table 1 presents the descriptive statistics for 5-min intra-day returns and daily returns for the full sample. The returns are based on the midpoint of the bid-ask quotes. The average intra-day gold spot and futures returns are positive when the full trading day is considered and negative during the business hours of the S&P500 (S&P500 open-to-close). In addition, the standard deviations of gold returns are larger when the S&P500 is traded compared to the full day suggesting that equity market trading is generating gold-relevant information and thus increasing the volatility of gold.

The average correlations between S&P500 and gold intra-day returns are displayed in Table 2 and are all positive. The correlation between the gold spot and gold futures returns is 0.93 and the correlation between the S&P 500 and gold returns is 0.1. Moreover, the correlation estimates between the gold spot and futures appear to be unaffected by different trading times throughout the day.

2.2. Descriptive Analysis

This section compares the average performance of the gold price and the S&P500 over the full sample period with their performance on days when the S&P500 exhibits strong declines, i.e. extreme negative returns. We define "extreme" days by daily open-to-close equity returns that fall below -4.5 percent. Using this threshold, our subset of "extreme" days contains the top 10 days with the most severe open-to-close price declines of the S&P500. In this subset, open-to-close S&P500 returns are only negative and range from -8.85 to -4.56 percent with an average of -6.43 percent.

These extreme days and their returns are displayed in Table 3; Detailed descriptive statistics for the returns of the two assets on extreme days are presented in Table 4. Interestingly, the standard deviations of the returns are significantly larger on extreme return days compared to the full sample period for both assets, i.e. despite moving in opposite directions, both assets experience significantly larger fluctuations on extreme return days than on average return days. It appears that the increased volatility in the stock market

[3]The RICs are `.SPX`, `XAU=` and `GCc1`, for S&P500, gold spot and gold futures, respectively. We gratefully acknowledge access to Thomson Reuters TickHistory through the Hohenheim DataLab (DALAHO).

Table 1: The table presents descriptive statistics of 5-min intra-day and daily returns for the S&P 500 (.SPX), gold spot (XAU=) and gold futures (GCc1) for the full sample period (January 03, 2007 until July 13, 2018).

	Mean	Std.Dev.	Skew	Kurt	Min	Max	Obs
Intra-day							
S&P 500	$0.212 \cdot 10^{-5}$	0.1069	0.35	38.69	−2.6796	3.9496	223377
Gold	$5.753 \cdot 10^{-5}$	0.0714	−0.16	44.92	−2.9520	2.9324	692447
Gold futures	$4.895 \cdot 10^{-5}$	0.0714	−0.14	41.51	−2.8215	2.3018	688825
Intra-day (S&P 500 open-to-close)							
Gold	$-6.451 \cdot 10^{-5}$	0.0875	−0.19	31.95	−2.9520	2.1864	223554
Gold futures	$-6.116 \cdot 10^{-5}$	0.0886	−0.14	33.41	−2.8215	2.3018	221256
Daily (open-to-close)							
S&P 500	$-0.5748 \cdot 10^{-2}$	0.9919	−0.67	15.00	−8.8461	7.2399	2861
Gold	$1.4483 \cdot 10^{-2}$	1.0603	−0.14	10.32	−7.5400	10.1064	2846
Gold futures	$2.7277 \cdot 10^{-2}$	1.0755	−0.09	10.32	−7.6572	10.2744	2803
Daily (S&P 500 open-to-close)							
S&P 500	$-0.5748 \cdot 10^{-2}$	0.9919	−0.67	15.00	−8.8461	7.2399	2861
Gold	$-0.2075 \cdot 10^{-2}$	0.7682	0.37	21.19	−7.7230	10.1064	2950
Gold futures	$-0.2051 \cdot 10^{-2}$	0.7710	0.34	20.77	−7.8344	10.0147	2950
Daily (close-to-close)							
S&P 500	$2.1119 \cdot 10^{-2}$	1.2148	−0.42	11.64	−9.5741	10.2671	2743
Gold	$1.3943 \cdot 10^{-2}$	1.1192	−0.52	8.31	−9.0599	6.8685	2719
Gold futures	$2.3441 \cdot 10^{-2}$	1.1754	−0.22	10.34	−9.0445	10.7649	2532

Note, the statistics for the intra-day returns are based on 5-min intra-day returns over the complete trading day or during the business hours for the S&P 500 (9:30–16:00 local time).

Table 2: Correlations between intra-day returns (full sample).

	S&P 500	Gold	Gold futures
Full day			
S&P 500	1		
Gold	0.0991^{***}	1	
Gold futures	0.0999^{***}	0.9291^{***}	1
S&P 500 open-to-close			
S&P 500	1		
Gold	0.0991^{***}	1	
Gold futures	0.0999^{***}	0.9320^{***}	1
S&P 500 close-to-open (overnight)			
Gold		1	0.926^{***}

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Top 10 extreme dates in the equity market (sorted descending by S&P 500 loss).

Date	S&P 500	Gold	Gold futures
09-May-11	−8.85	0.32	0.30
09-Oct-08	−8.48	3.25	3.34
15-Oct-08	−7.22	1.41	1.41
07-Oct-08	−6.39	0.04	0.25
29-Sep-08	−6.05	2.98	3.00
19-Nov-08	−6.03	−1.55	−1.60
20-Nov-08	−6.02	0.44	0.41
01-Dec-08	−5.63	−1.64	−1.63
08-Aug-11	−5.08	1.24	1.21
06-Nov-08	−4.56	−2.89	−2.96

Note, the table displays open-to-close returns computed during the business hours for the S&P 500 (9:30–16:00 local time).

spills over to the gold market. The result is also consistent with a different asymmetric volatility effect of gold compared with stocks as documented in the literature (Baur, 2012).[4]

On extreme days (see Table 5), the correlation between the S&P500 and gold spot is positive and marginally negative with gold futures. Moreover the correlation between gold spot and futures returns tends to be affected by different trading times throughout the trading day.

Figure 1 depicts the aggregate intra-day returns for two key dates of the global financial crisis (GFC). September 15, 2008 can be considered the start of the GFC with the Lehman bankruptcy and October 15, 2008 marks the largest negative return of the S&P500 (-8.3%) in the sample. The graphs illustrate the negative relationship between the two series once the S&P500 starts to display extreme negative price changes.

Figure 2 displays two days when material news was released when the stock market was closed but the gold market was open.

On May 06, 2010 US stock markets fell sharply in response to news related to the Eurozone sovereign debt crisis. The other day is June 23, 2016 which marks the date of the Brexit referendum with important geopolitical implications. The graphs illustrate that gold acts as safe haven even before the news arrives in the stock market.

[4]Whilst negative shocks increase the volatility of stock returns by more than positive shocks, positive shocks increase the volatility of gold returns by more than negative shocks.

Table 4: The table presents descriptive statistics of 5-min intra-day and daily returns for the S&P 500 (.SPX), gold spot (XAU=) and gold futures (GCc1) for the top 10 most extreme days in the equity market during the period January 03, 2007 until July 13, 2018.

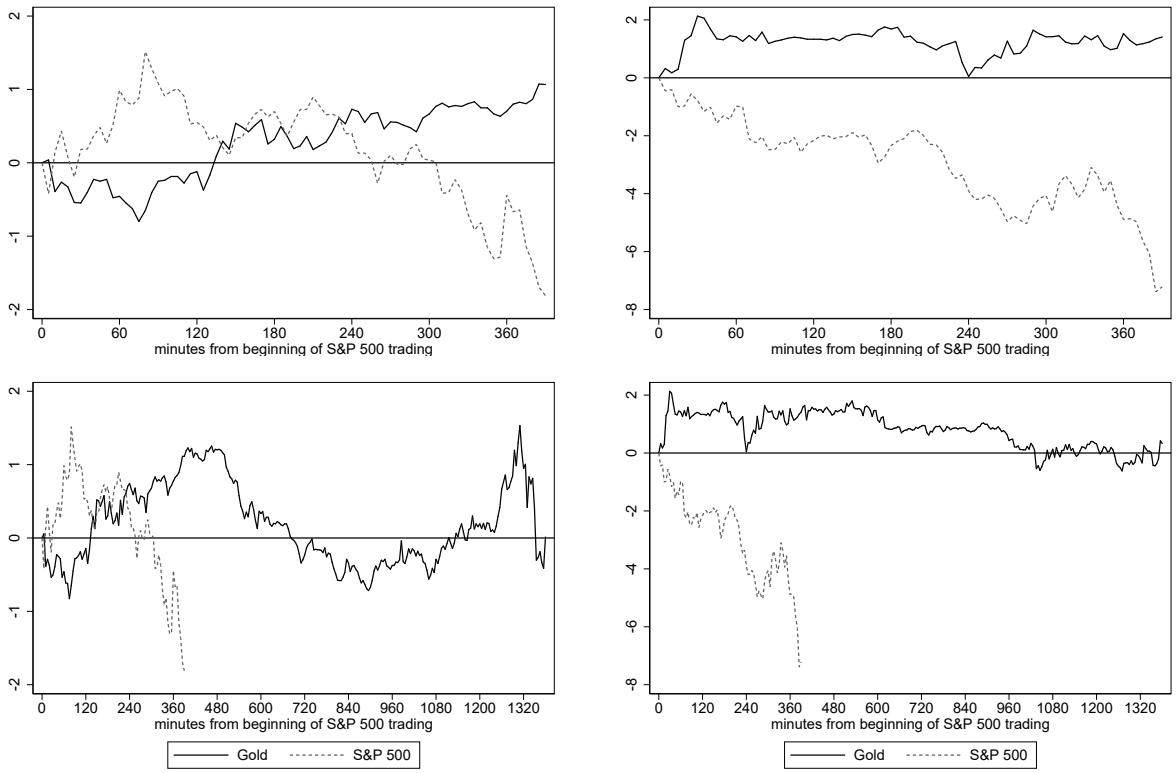
	Mean	Std.Dev.	Skew	Kurt	Min	Max	Obs
Intra-day							
S&P 500	$-7.0838 \cdot 10^{-2}$	0.3727	−0.17	5.59	−2.1728	1.5540	778
Gold	$0.2297 \cdot 10^{-2}$	0.1672	0.03	9.78	−1.0617	1.2513	2679
Gold futures	$0.3598 \cdot 10^{-2}$	0.1733	−0.12	11.06	−1.4130	1.2388	2756
Intra-day (S&P 500 open-to-close)							
Gold	$0.0926 \cdot 10^{-2}$	0.2141	0.31	7.96	−1.0284	1.2513	741
Gold futures	$0.5196 \cdot 10^{-2}$	0.2233	0.12	8.27	−1.2199	1.2388	786
Daily (open-to-close)							
S&P 500	−6.43	1.3792	−0.60	2.33	−8.8461	−4.5600	10
Gold	1.05	2.0458	−0.06	1.98	−2.4992	3.7160	10
Gold futures	1.05	2.0903	−0.06	2.02	−2.5963	3.7962	10
Daily (S&P 500 open-to-close)							
S&P 500	−6.43	1.3792	−0.60	2.33	−8.8461	−4.5600	10
Gold	0.36	1.9845	−0.08	2.07	−2.8935	3.2504	10
Gold futures	0.37	2.0139	−0.10	2.11	−2.9572	3.3417	10

Note, the statistics for the intra-day returns are based on 5-min intra-day returns over the complete trading day or during the business hours for the S&P 500 (9:30–16:00 local time).

Table 5: Correlations between intra-day returns (extreme days).

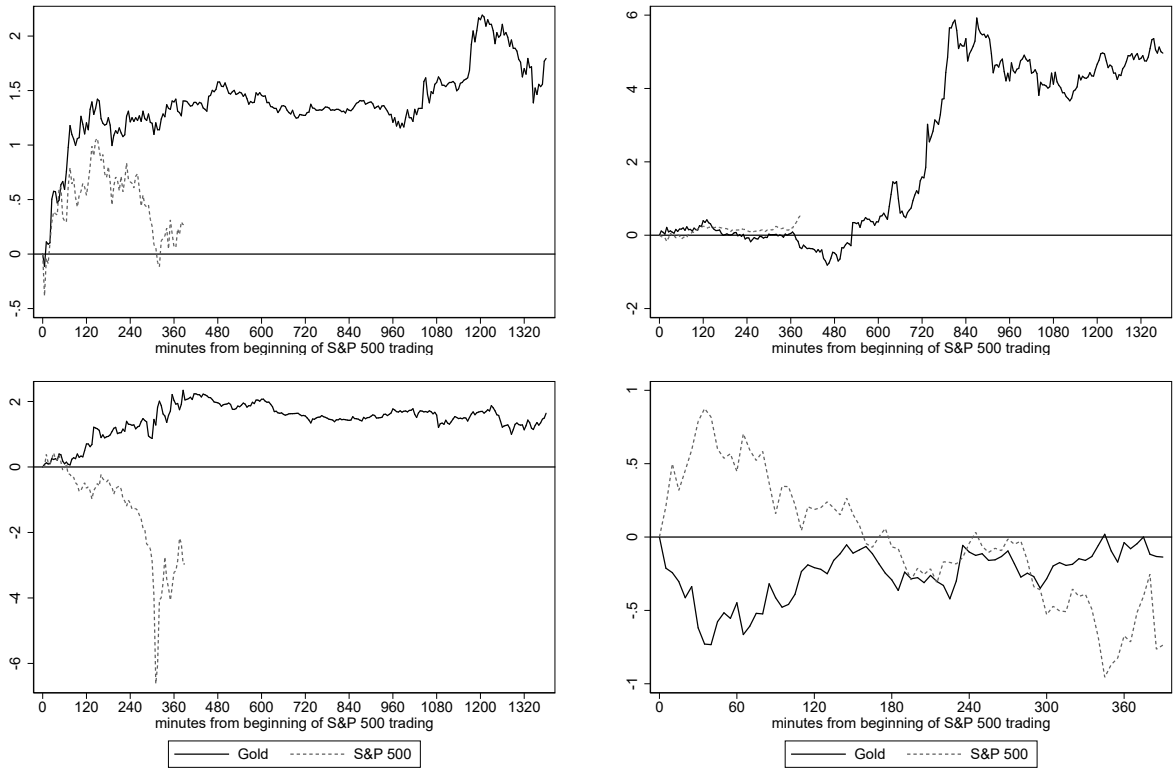
	S&P 500	Gold	Gold futures
Full day			
S&P 500	1		
Gold	0.0993^{***}	1	
Gold futures	$-.0135^{***}$	0.8937^{***}	1
S&P 500 open-to-close			
S&P 500	1		
Gold	0.0993^{***}	1	
Gold futures	$-.0135^{***}$	0.916^{***}	1
S&P 500 close-to-open (overnight)			
Gold		1	0.875^{***}

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$



(a) September 15, 2008 **(b)** October 15, 2008

Figure 1: The figure illustrates the negative relationship between the equity market and the gold spot on two key dates during the Global Financial Crisis (GFC).



(a) Eurozone sovereign debt shock - May 05, 2010 (top) and May 6, 2010 (bottom)

(b) Brexit shock - June 23, 2016 (top) and June 24, 2016 (bottom)

Figure 2: The figure illustrates the negative relationship between the equity market and the gold price for two extreme events during the sample period.

There are also (extreme) days where both the S&P500 and gold decline (e.g. November 19, 2008 or December 1, 2008). This finding may be interpreted as a contradiction to the safe haven property of gold documented in the literature (see e.g. Erb and Harvey, 2013). However, the safe haven property of an asset must be assessed in a broader and dynamic context of the financial market conditions, i.e. extreme days must be seen in the sequence of events and should not be analyzed in isolation. Gold fulfilled its safe haven role at the beginning of the GFC but only during the initial phase (see e.g. Baur and McDermott, 2016). Extreme return days in late October, November and December 2008 were potentially associated with the sale of gold to limit losses incurred in the stock market. Therefore, the safe-haven property is short-lived (Baur and Lucey, 2010) and negative gold returns during a financial crisis do not automatically and necessarily indicate that gold lost its safe haven property.

2.3. Average Cumulative Returns

This section analyzes the average evolution of S&P500 and gold prices over all days and over a subset of extreme negative returns of the S&P500. Therefore, we first construct the aggregate intra-day returns for each 5-minute interval $m = 1, 2, \ldots, M$ from the beginning of S&P500 trading on each day (14:30h/13:30h UTC, 09:30h local) until its opening the next day (14:25h/13:25h UTC, 09:25h local). Then, for each of these intervals, we compute the average over all days and, alternatively, over a subset of extreme days:

$$\bar{r}_m = \frac{1}{T} \sum_{t=1}^{T} r_{m,t},$$

where $r_{m,t} = \sum_{j=1}^{m} r_{j,t}$ denotes the cumulative intra-day return from the S&P500 market opening to the interval m on day t.

The average cumulative intra-day returns of the S&P 500 and gold futures for the full sample are depicted in Figure 3. Figure 4 presents a similar graph but extends the trading hours until the opening of trading in the equity market the day (open-to-open). The graphs illustrate the low average correlation of the two assets and their volatility.

Figures 5 and 6 present the average intra-day returns for the subset of extreme days in the stock market and show a relatively stable and positive evolution of gold returns contrasted by the continuously decreasing cumulative S&P500 returns. The relative stability of gold prices on average confirms the safe haven property

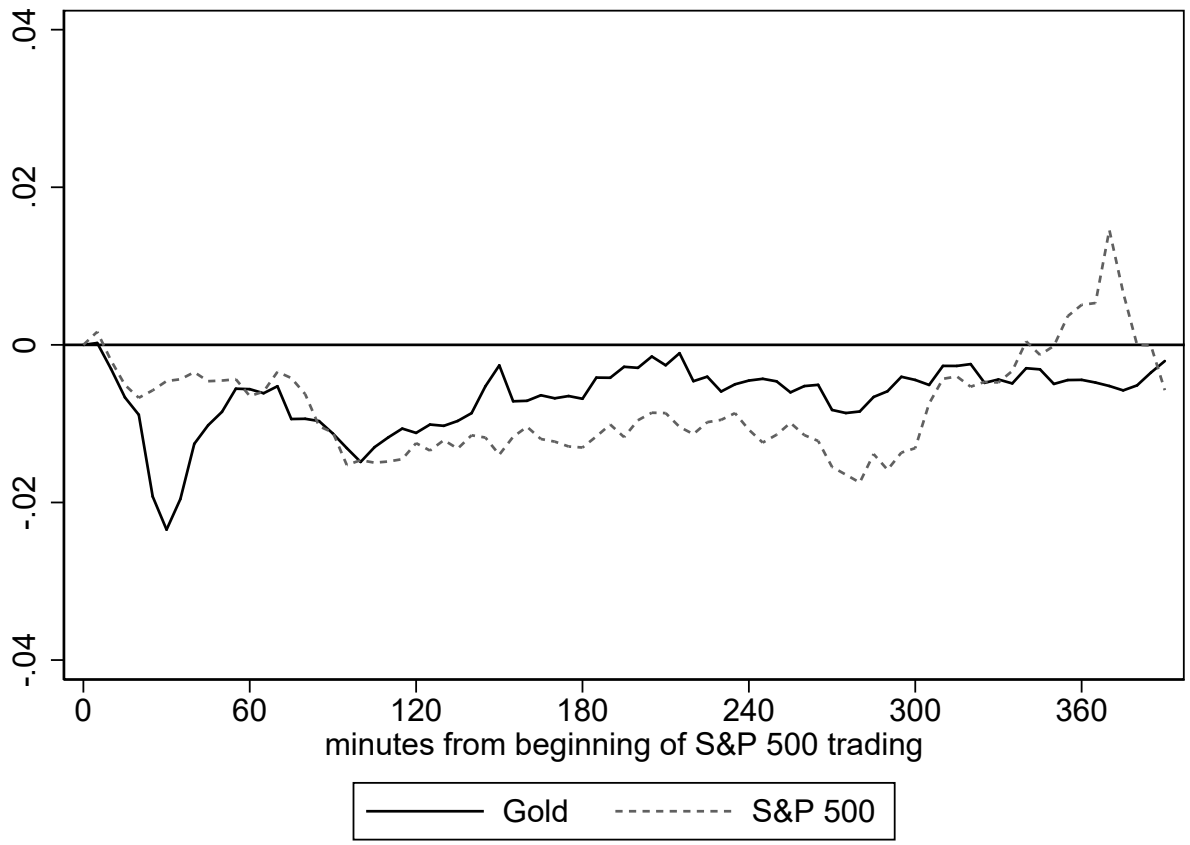


Figure 3: The graph shows the average cumulative 5-minute returns for the S&P500 and gold futures for the full sample period (S&P open-to-close).

of gold and clearly illustrates that gold does (on average) not co-move with the stock market in extreme conditions. The Figures also show that cumulative average gold returns are not consistently positive over all days of extreme negative stock market returns but turn and remain positive if stock market returns fall by more than 3% within the first 4 hours of stock trading. Figure 6 also reveals that the gold price continues to rise during the overnight period after the end of S&P500 trading on extreme days. The cumulative gold returns are clearly positive on such days but the average cumulative gold return is only about 1%. The reason for the rather small increase of gold prices relative to the fall in equity valuations could be that the buying pressure on gold due to a flight from stocks to gold is compensated by investors who sell gold to cover losses incurred in the stock market. Another reason may be that most investors already hold gold and do not buy additional gold in reaction to extreme negative stock market returns.

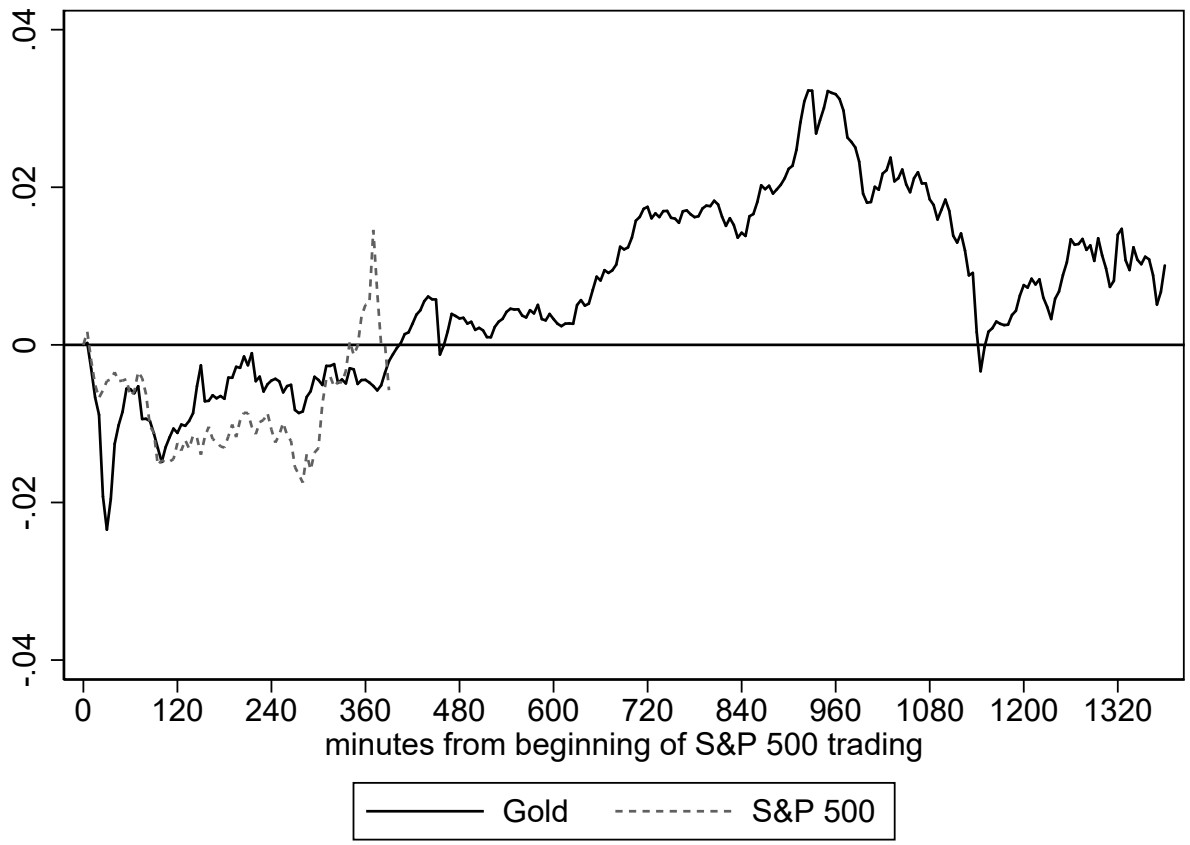


Figure 4: The graph shows the average cumulative 5-minute returns for the S&P500 and gold futures for the full sample period (S&P open-to-open).

Finally, Figure 7 illustrates how the correlation changes throughout the trading day and turns negative on extreme days towards the end of the trading day. The graph presents the correlation estimates based on forward-rolling 30-min gold and S&P500 returns across all (extreme) days.[5]

2.4. Econometric Analysis

To investigate the cross-market dynamics of gold and equity in adverse conditions in the equity market, we estimate a safe haven regression model to test if large negative shocks of the S&P500 are associated with immediate[6] (positive) reactions of the gold price. Specifically, to account for conditional heteroscedasticity

[5] Graphs for higher frequency (5min, 10min) return correlations can be obtained from the authors.
[6] We interpret a reaction within 5 minutes as "immediate".

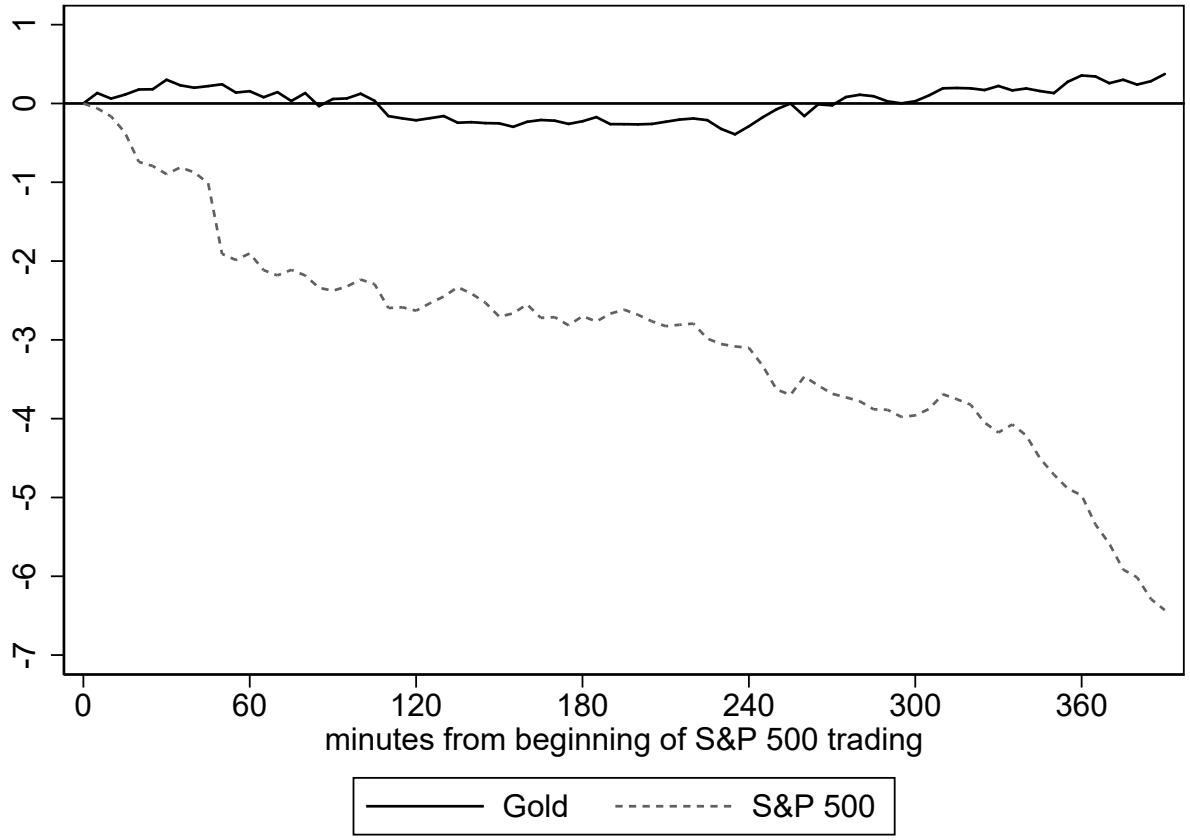


Figure 5: The figure shows the average cumulative 5-minute returns for the S&P500 and gold futures on "extreme" days (S&P open-to-close).

in the time series of intra-day gold and equity returns we estimate the following asymmetric Glosten et al. (1993) GARCH model:

$$r_{\text{gold},t} = a + b_t r_{\text{S\&P500},t} + e_t \tag{1}$$

$$b_t = c_1 D(r_{\text{S\&P500},t} < -.30) + c_2 D(r_{\text{S\&P500},t} < -.50) + c_3 D(r_{\text{S\&P500},t} < -.75) + c_3 D(r_{\text{S\&P500},t} < -1.00) \tag{2}$$

$$h_t = \omega + \alpha e_{t-1}^2 + \gamma D(e_{t-1} > 0) e_{t-1}^2 + \beta h_{t-1} \tag{3}$$

$$e_t \sim N(0, h_t), \tag{4}$$

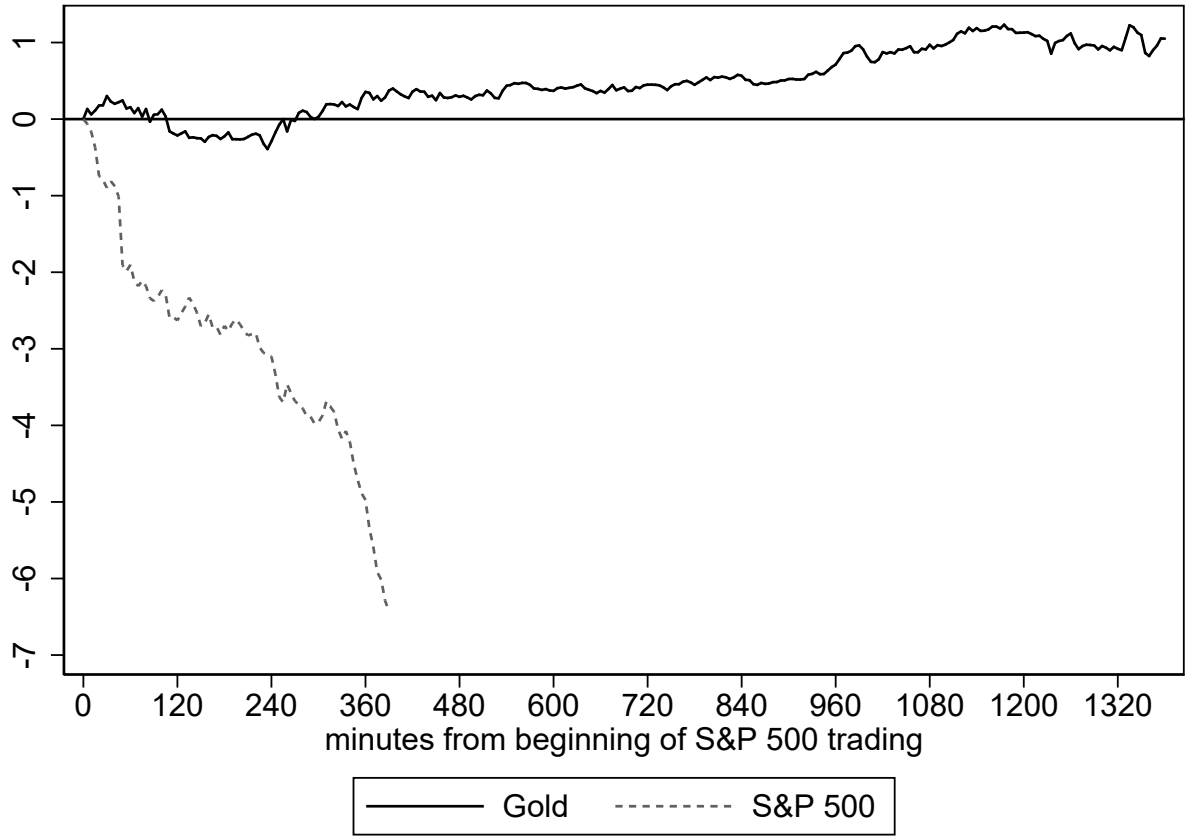
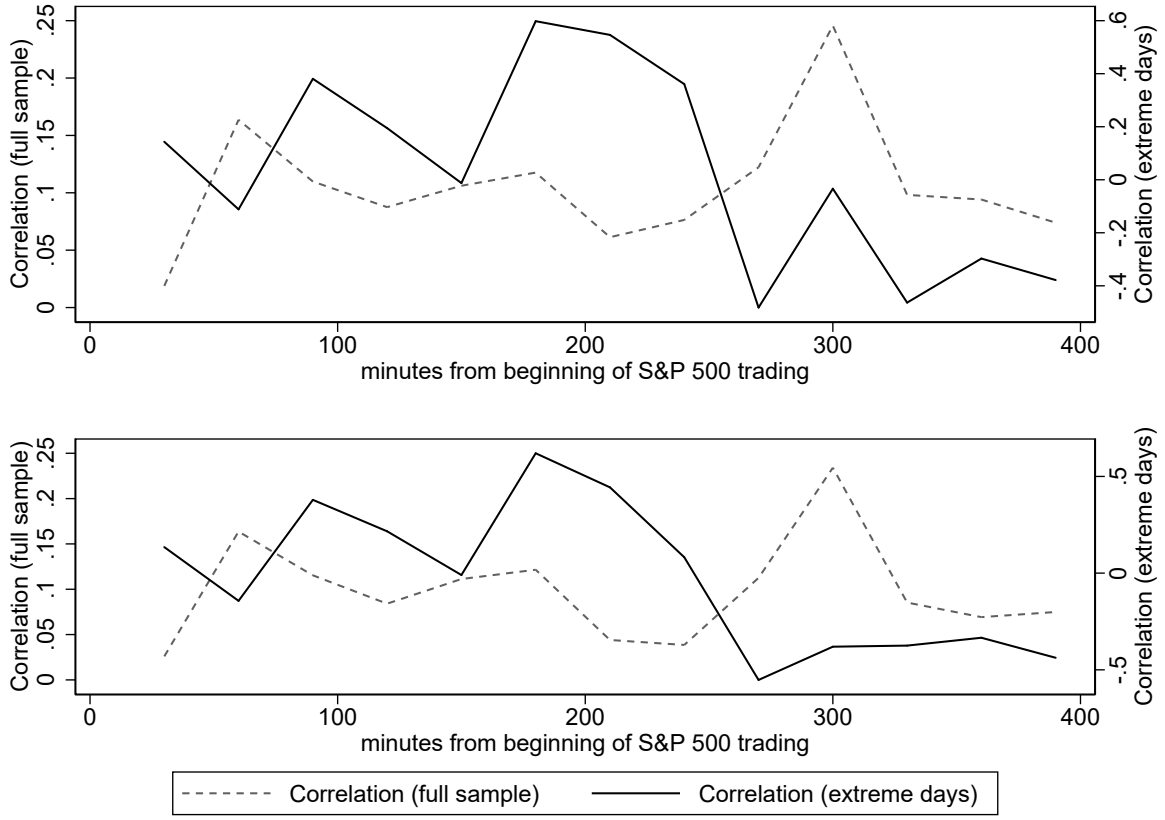


Figure 6: The graph shows the average cumulative 5-minute returns for the S&P500 and gold futures on "extreme" days (S&P open-to-open).

where $D(\cdot)$ is an indicator function that takes on the value of 1 if its argument is true, and 0 otherwise.[7] This model is similar to the one proposed in Baur and Lucey (2010) for daily data but uses intra-day 5-minute returns and enables us to study the presence of short-term reactions of gold to negative stock market *shocks* of different magnitudes.

Table 6 reports the estimation results and shows that only extreme negative S&P500 returns that materialize over a short intra-day time horizon exhibit negative and statistically significant coefficients implying a positive reaction of gold. More specifically, in the rare case of a negative shock exceeding -1%, gold acts as a weak safe haven over short intra-day time horizon(s). That is, in the 58 cases of negative 5-min returns smaller than -1% in our sample, gold and the S&P500 appear contemporaneously uncorrelated.

[7]Note that this specification of the Glosten et al. (1993)-GARCH model is specific to STATA. A negative and significant coefficient estimate for γ implies that positive shocks increase the variance by less than negative shocks.



Notes: Upper panel: Gold spot and S&P500 returns. Lower panel: Gold futures and S&P500 returns.

Figure 7: The figure shows the correlation between 30-min intra-day gold and S&P500 returns in the full sample and for "extreme" days.

Less pronounced negative S&P500 returns, by contrast, do not imply a positive reaction of gold. The fact that gold only positively reacts to extreme negative shocks is fully consistent with the notion of a safe haven asset. If gold returns were positive at all times gold would be a perfect "safe asset" in the sense of Gorton (2017) but not a typical "safe haven" (Baur and McDermott, 2016).

The additional quantile regression estimates reported in Tables 7 provide an alternative to the GARCH-framework and a robustness analysis. The results confirm the findings reported above and also show that there are significant differences between the lower quantile and the upper quantile estimates. The strongest safe haven effects are found for the upper quantiles when gold exhibits large positive returns, the results are weaker for lower quantiles when gold exhibits negative returns. Another interesting observation is the

increased persistence of gold returns in the extreme tails of the distribution. The AR(1) estimates are positive and highly significant in both the 1% and the 99% quantiles compared to a negative AR(1) coefficient at the 50% quantile and thus in the center of the distribution.

3. Summary and Concluding Remarks

This paper extended existing research on the safe haven property of gold by demonstrating that the safe haven property of gold can also be identified at short 5-min time intervals. The use of intra-day data instead of lower frequency daily data allowed us to better understand the timing of extreme events, flight to quality and the safe haven effect. We find that gold returns react fast to extreme negative changes in the S&P500 but that extreme returns over an entire trading day evolve relatively slowly. The fact that extreme stock market movements do not occur over a 5-min period but generally extend over several hours also means that the full extent of flight to quality builds over several hours. The analysis in this paper points to the importance of using high-frequency intra-day data to better understand the dynamics of crashes and the role of gold.

References

Batten, J., Lucey, B., McGroarty, F., Peat, M., Urquhart, A., 2017. Stylized facts of intraday precious metals. PLoS ONE 12 (4).

Baur, D., McDermott, T., 2010. Is gold a safe haven? international evidence. Journal of Banking & Finance 34 (8), 1886–1898.

Baur, D. G., 2012. Asymmetric volatility in the gold market. The Journal of Alternative Investments 14 (4), 26–38.

Baur, D. G., Lucey, B. M., 2010. Is gold a hedge or a safe haven? an analysis of stocks, bonds and gold. Financial Review 45 (2), 217–229.

Baur, D. G., McDermott, T. K., 2016. Why is gold a safe haven? Journal of Behavioral and Experimental Finance 10, 63 – 71.

Erb, C. B., Harvey, C. R., 2013. The golden dilemma. Financial Analysts Journal 69 (4), 10–42.

Glosten, L. R., Jagannathan, R., Runkle, D. E., 1993. On the relation between the expected value and the volatility of the nominal excess return on stocks. The Journal of Finance 48 (5), 1779–1801.

Gorton, G., 2017. The history and economics of safe assets. Annual Review of Economics 9 (1), 547–586.

Ranaldo, A., Söderlind, P., 2010. Safe haven currencies. Review of Finance 14 (3), 385–407.

Table 6: Safe haven regression model based on 5-minute intra-day gold spot and futures returns (GJR-GARCH)

	Gold		Gold		Gold futures		Gold futures	
Mean equation								
Constant	0.0001	(0.91)	0.0001	(1.04)	0.0001	(0.82)	0.0001	(0.76)
S&P 500 return$_t$	0.0457***	(59.43)	0.0407***	(30.11)	0.0498***	(62.18)	0.0424***	(31.78)
S&P 500 return$_t < -.30$	0.0394***	(16.91)	0.0029	(0.64)	0.0289***	(12.74)	0.0053	(1.17)
S&P 500 return$_t < -.50$	−0.0119***	(−3.37)	0.0227**	(2.81)	−0.0009	(−0.23)	0.0201*	(2.54)
S&P 500 return$_t < -.75$	0.0006	(0.09)	0.0310*	(2.12)	0.0355***	(6.73)	0.0381**	(2.83)
S&P 500 return$_t < -1.0$	−0.1350***	(−19.74)	−0.0899***	(−5.33)	−0.1680***	(−29.98)	−0.0869***	(−5.10)
AR(1)	−0.0285***	(−26.63)	−0.0696***	(−34.31)	−0.0157***	(−13.25)	−0.0599***	(−29.41)
S&P 500 return$_{t-1}$	0.0049***	(4.85)	0.0066***	(5.11)	0.0037***	(3.53)	0.0060***	(4.72)
Variance equation								
ω	0.0000***	(75.98)	0.0000***	(23.63)	0.0000***	(76.48)	0.0000***	(23.05)
α	0.1300***	(186.97)	0.1240***	(58.22)	0.1280***	(185.31)	0.1250***	(58.22)
β	0.8660***	(2078.60)	0.8730***	(645.89)	0.8660***	(2064.48)	0.8730***	(655.03)
γ	−0.0065***	(−7.34)	−0.0154***	(−6.09)	−0.0060***	(−6.73)	−0.0162***	(−6.42)
ν			4.274				4.2075	
Observations	218,048		218,048		216,053		216,053	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: ν denotes the degrees of freedom of the *t*-distribution

Table 7: Quantile Safe Haven Regression based on 5-minute returns for different quantiles.

	$\tau = .01$		$\tau = .05$		$\tau = .10$		$\tau = .50$	
Constant	-0.2450^{***}	(-126.83)	-0.1190^{***}	(-189.56)	-0.0774^{***}	(-211.43)	0.0001	(1.19)
S&P 500 return$_t$	-0.0126	(-0.61)	0.0297^{***}	(4.39)	0.0420^{***}	(10.63)	0.0573^{***}	(45.43)
S&P 500 return$_t < -.30$	1.1040^{***}	(17.70)	0.6160^{***}	(30.49)	0.4449^{***}	(37.52)	0.0118^{**}	(3.12)
S&P 500 return$_t < -.50$	-0.3830^{***}	(-4.09)	-0.0388	(-1.28)	-0.0508^{**}	(-2.86)	0.0209^{***}	(3.69)
S&P 500 return$_t < -.75$	-0.0857	(-0.65)	-0.0846^{*}	(-1.98)	-0.0278	(-1.11)	-0.0128	(-1.60)
S&P 500 return$_t < -1.00$	-0.3510^{*}	(-2.45)	-0.2970^{***}	(-6.38)	-0.2290^{***}	(-8.40)	-0.0816^{***}	(-9.39)
AR(1)	0.0764^{***}	(3.46)	0.0036	(0.50)	-0.0278^{***}	(-6.63)	-0.0722^{***}	(-53.97)
S&P 500 return$_{t-1}$	0.0106	(0.58)	0.0115	(1.95)	0.0109^{**}	(3.15)	0.0054^{***}	(4.88)
Observations	218,048		218,048		218,048		218,048	
	$\tau = .90$		$\tau = .95$		$\tau = .99$			
Constant	0.00305	(0.91)	0.0043	(0.77)	0.0180	(1.00)		
S&P 500 return	0.0786^{***}	(222.33)	0.1180^{***}	(198.95)	0.2340^{***}	(123.39)		
S&P 500 return$_t < -.30$	0.143^{***}	(37.49)	0.1790^{***}	(27.81)	0.2420^{***}	(11.83)		
S&P 500 return$_t < -.50$	-0.429^{***}	(-37.59)	-0.5650^{***}	(-29.36)	-0.8000^{***}	(-13.08)		
S&P 500 return$_t < -.75$	0.0657^{***}	(3.83)	0.0027	(0.09)	-0.0821	(-0.89)		
S&P 500 return$_t < -1.00$	-0.0800^{***}	(-3.31)	-0.0038	(-0.09)	-0.1600	(-1.23)		
AR(1)	0.189^{***}	(7.18)	0.0527	(1.19)	0.4400^{**}	(3.12)		
S&P 500 return$_{t-1}$	-0.0493^{***}	(-12.19)	-0.0318^{***}	(-4.67)	-0.0040	(-0.19)		
Observations	218,048		218,048		218,048			

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$