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The impact of positive and negative macroeconomic news surprises: Gold versus Bitcoin

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Abstract

We examine the impact of positive versus negative macroeconomic news surprises, originating from large developed economies, on the returns and volatility of gold and Bitcoin prices over the period July 19, 2010 – February 7, 2017. We find an asymmetric impact and evidence that gold is different from Bitcoin. Specifically, gold returns and volatility systematically react to macroeconomic news surprises in a manner consistent with its traditional role as a safe-haven, whereas Bitcoin prices and volatility do not mostly react in a similar manner. Our results are useful for investment decision-making.

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1. Introduction

Gold belongs to the family of commodities that are affected by macroeconomic news (Caporale et al., 2017), especially the surprise element in macroeconomic news (Roache and Rossi, 2009). Commodity prices show a positive co-movement with macroeconomic news, except for gold prices that tend to exhibit a negative co-movement (Elder et al., 2012) given its safe-haven property (Baur and Lucey, 2010). Specifically, gold returns exhibit larger reactions to positive economic news (Smales and Yang, 2015), whereas gold volatility is more sensitive to negative news (Smales, 2015). Importantly, the positive return-volatility relationship in the gold market is attributed to a safe-haven property (Baur, 2012).

Financial market participants have been recently fascinated by a new asset class, called cryptocurrencies, that is independent of central authorities and relies only on peer-to-peer networking and cryptographic proofing[1]. After being introduced in Nakamoto (2008) as an alternative online payment system, the first and most popular cryptocurrency – Bitcoin – has become an appealing investment vehicle given the tradability of its unit (Polasik et al., 2015). Importantly, Bitcoin is perceived by many as an alternative to sovereign physical currencies and a shelter during times of weak confidence in the global financial system. For example, Bitcoin gained more ground and value during the Greek and European sovereign debt crisis, (Bouri, 2017a; Luther and Salter, 2017), the Cypriot banking crisis[2], and the Brexit[3]. Surprisingly, Bitcoin price surpassed the price of one ounce of gold in April 2017[4], triggering voluminous press articles comparing Bitcoin to gold.

While gold differs from Bitcoin in several aspects, such as tangibility, long history, intrinsic value, low volatility, and usage in the production process, it shares with Bitcoin some common characteristics. Like gold, Bitcoins are (1) classified as a commodity by the US Commodity Futures Trading Commission, (2) "mined", (3) uncontrolled by a central political authority, (4) scarce with a limited supply[5], (5) inflation-proof (Richardson, 2014; Baur et al., 2015). Furthermore, Bitcoin is entitled synthetic commodity money by Selgin (2015) and digital gold by Popper (2015). For Baur et al. (2015), Bitcoin is a hybrid digital commodity very useful for diversification purposes - like gold. Dyhrberg (2016) locates the hedging capability of Bitcoin somewhere near gold, whereas Bouri et al. (2017b) argue that Bitcoin exhibits a positive return-volatility relationship quite similar to gold (Tully and Lucey, 2007; Baur, 2012). Bouri et al. (2017c) show that Bitcoin is a hedge against global uncertainty, measured by the first principal component of the implied volatility indices of 14 developed and developing equity markets. Studies of price formation in the Bitcoin market show that trading volume (Balcilar et al., 2017) and Bitcoin attractiveness – search queries – are highly important, whereas macro-financial development has a marginal role (Bouoiyour et al., 2016; Kristoufek, 2015; Ciaian et al., 2016). However, Li and Wang (2017) argue that Bitcoin returns are affected by the changes in economic fundamentals. Bouoiyour et al. (2016) also show that Bitcoin is driven by long-term fundamentals.

The above discussions point to at least three research gaps. The first relates to the impact of positive/negative macroeconomic news surprises on Bitcoin returns and volatility, especially with the increasing interest in Bitcoin as an investment vehicle. The second relates to whether that impact on Bitcoin is similar or dissimilar to that reported on gold, particularly given the

[1] The principles of Bitcoin are described in Dwyer (2015).

[2] https://www.cnbc.com/id/100597242

[3] https://www.cnbc.com/2016/06/27/bitcoin-gains-validity-as-digital-gold-after-brexit-vote.html

[4] By the end of July 2017, Bitcoin price reached $2.873,83 while gold closed at $ 1.268,49.

[5] Bitcoin supply is predetermined by an algorithm. It is limited to no more 21 million coins.

inconclusive debate arising from the continuous comparison between the virtues of gold and Bitcoin. The third relates to whether the sign of the impact is consistent with that of a traditional safe-haven asset, i.e. in the presence of positive macroeconomic news surprises the returns (volatility) of a safe-haven asset should increase (decrease); the opposite should be true in the case of negative news surprises[6]. Addressing those gaps is useful to market participants, given that evidence of significant impact implies eventual predictability. Furthermore, any evidence of similarity in the impact of news surprises between gold and Bitcoin markets means that both markets share same fundamentals, rendering news surprises an important (common) factor in explaining and predicting market dynamics.

Using an interesting dataset on macroeconomic news surprises - originated from the US, Canada, the Euro Area, UK, and Japan - recently constructed by Scotti (2016), we employ a suitable GARCH framework (Cai et al., 2001; Cakan et al., 2015) that allows for dealing with time variation and clustering of volatilities - two features that are present in our gold and Bitcoin data[7]. Our analyses show an asymmetric impact on the returns and volatility of both gold and Bitcoin. The overall impact of macroeconomic news surprises, both negative and positive, is stronger for gold than Bitcoin. However, unlike Bitcoin, the sign of the impact on gold returns and volatility is consistent with gold's traditional role as a safe-haven.

The rest of the paper is divided into three sections. The next section describes the data and methodology. The section that follows presents and discusses the empirical results, whereas the final section concludes.

2. Data and econometric model

2.1. The dataset

Data on macroeconomic news surprises are from Scotti (2016), available at: https://sites.google.com/site/chiarascottifrb/research/surprise-and- uncertainty-indexes. They cover daily indices for US, Canada, Euro area, UK, and Japan. According to Scotti (2016), the index of macroeconomic news surprises summarizes "recent economic data surprises and measures optimism/pessimism about the state of the economy". It is updated whenever new information becomes available. Accordingly, the index level will remain unchanged for the next day unless new economic releases have favorably or unfavorably affected its level. Our empirical analyses use the changes in the index's level. Specifically, an increase in the level of the macroeconomic news surprises index would signal that the economy is doing better than expected and vice-versa.

Daily spot prices of gold per ounce are from the World Gold Council (www.gold.org). As for Bitcoin daily prices, they are extracted from Coindesk (www.coindesk.com/price) that computes the average price across leading Bitcoin exchanges (Bouri et al., 2017a). Both gold and Bitcoin prices are denominated in USD and depicted in Figure 1. Our sample period spans from July 19, 2010 to February 7, 2017, where its starting is depicted by the availability of Bitcoin prices, while its ending is depicted by the availability of macroeconomic news surprises data. Importantly, we use the logarithmic returns of gold and Bitcoin in our empirical analyses.

[6] Independence from macroeconomic news releases is not enough for an asset to be considered as a safe-haven. Instead, a safe-haven must react to macroeconomic news releases in a manner consistent with that of a safe haven role, i.e. asset returns and volatility should increase in response to negative news surprises and vice-versa (Roache and Rossi, 2009; Baur, 2012; Elder et al., 2012).

[7] Bouoiyour and Selmi (2016) apply a GARCH-based approach while estimating Bitcoin price dynamics.

Figure 1. Plot of price series

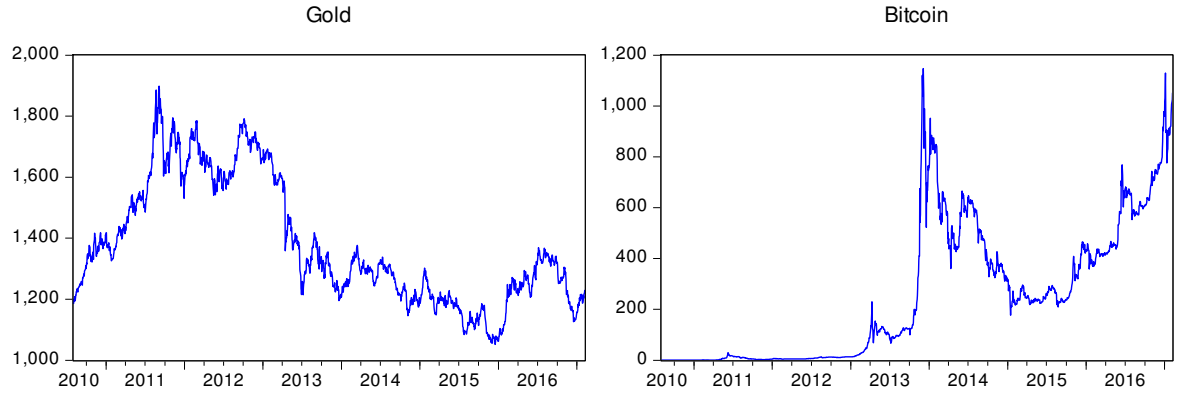

Table 1a. Summary statistics

			Index of macroeconomic news				
	Gold	Bitcoin	US	UK	Euro Area	Japan	Canada
Mean	0.0024	0.5543	-0.109	0.000	-0.005	-0.088	0.138
Standard Deviation	1.0611	6.8727	0.386	0.261	0.342	0.235	0.392
Skewness	-0.8164	0.1295	-0.076	-0.543	-0.020	-0.319	0.334
Kurtosis	10.609	14.144	-0.039	1.188	0.097	0.458	-0.528
Jarque-Bera	4318.0	8859.0	-	-	-	-	-
Probability	0.0000	0.0000	-	-	-	-	-
Observations	1711	1711	1711	1711	1711	1711	1711

Notes: This table provides summary statistics and unit root tests for the returns of gold and Bitcoin and the 5 indices of macroeconomic news. The sample period is from July 19, 2010 to February 7, 2017.

Table 1b. Heteroscedasticity and unit root tests

	Gold	Bitcoin
LM-ARCH(10)	3.356**	20.123**
LM-ARCH(20)	2.065**	11.664**
LM-ARCH(30)	1.615*	8.008**
ADF	-42.0650**	-17.7176**
PP	-42.0733**	-42.2924**

Notes: This table presents heteroscedasticity and unit root tests for the returns of gold and Bitcoin from July 19, 2010 to February 7, 2017. LM-ARCH statistics are for the Lagrange Multiplier heteroscedasticity test of Engle under the null hypothesis of no ARCH effects; For Augmented Dickey fuller (ADF) and Phillips Perron (PP) tests, the null hypothesis is that the series is integrated of order one; the two tests are conducted with a constant; the lag length of ADF is zero for gold and 3 for Bitcoin; for PP, the bandwidth is 6 for gold and 14 for Bitcoin; ** and * denote statistical significance at 1% and 5%, respectively.

The summary statistics are given in Table 1a. Bitcoin has a higher level of daily mean and volatility than gold (Bouri et al., 2017b). Both the return series of gold and Bitcoin have excess kurtosis and no-zero skewness. The Jarque-Bera statistics indicate that the two return series don't follow a normal distribution. Regarding the five indices of macroeconomic news, the lowest mean is shown for the US, whereas the highest mean and standard deviation are reported for the case of Canada. Results from Table 1b show that the Engle Lagrange multiplier (LM)-ARCH statistics reject the null hypothesis of no conditional heteroscedasticity at lags 10, 20, and 30, suggesting the appropriateness of using GARCH-based models capable of modeling the time-dependence in the variance of returns (Dyhrberg, 2016; Bouri et al., 2017b). Results from Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests show that the null of unit root in the returns series of gold and Bitcoin is rejected.

2.2. Econometric models

We model the impact of macroeconomic news surprises on the conditional returns and volatility via a GARCH-based framework augmented by dummy variables.

2.2.1. The baseline models

Our baseline model assumes no differential response of returns and volatility to positive versus negative news surprises. Let $R_{k,t}$ be the returns on each of gold and Bitcoin price series in day t (k = gold, Bitcoin). The mean equation is:

$$R_{k,t} = C + \sum_{j=1}^{J} \varphi_j \, Q_t^{i,j} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = z_t \, \sigma_t$$

The variance equation of a standard GARCH model is:

$$\sigma^2_{R_{k,t}} = \omega + \alpha \varepsilon^2_{t-1} + \beta \sigma^2_{R_{k,t-1}} + \sum_{j=1}^{J} \varphi_j \, Q_t^{i,j} \quad (2)$$

where $\omega > 0$, $\alpha \geq 0$, $\beta \geq 0$, and $\alpha + \beta < 1$; $\sum_{j=1}^{J} \varphi_j \, Q_t^{i,j}$ captures the impact of the change in macroeconomic news surprises; *i* and *J* denote the change in the macroeconomic news surprises and the country (US, Canada, Euro area, UK, and Japan), respectively.

The variance equation of the EGARCH[8] model is:

$$Log \, \sigma^2_{R_{k,t}} = \omega + \alpha\big(|z_{t-1}| - E\,[|z_{t-1}|]\big) + \gamma_m + \beta \, (Log \, \sigma^2_{R_{k,t-1}}) + \sum_{j=1}^{J} \varphi_j \, Q_t^{i,j} \quad (3)$$

where γ captures the asymmetry of innovation. It is significant if $\gamma_m \neq 0$.

2.2.2. The extended models

Our macroeconomic news surprises variable so far doesn't discriminate between positive and negative surprises. Should the reaction of returns (volatility) to positive news surprises differs from that to negative news surprises, the models presented in Equations 1-3 become too restrictive to capture such nuanced reactions. Importantly, it is possible that positive news surprises and negative news surprises cancel each other leading to insignificant results. Therefore, we split the macroeconomic news surprises into two components, $\varphi_j^{positive}$ and $\varphi_j^{negative}$, while adding two dummy variables, d_1 and (1-d_1), where $d_t = 1$ if the macroeconomic news surprises are positive and 0 otherwise. The extended mean equation becomes:

$$R_{k,t} = C + \sum_{j=1}^{J} \varphi_j^{positive} \, d_t^j Q_t^j + \sum_{j=1}^{J} \varphi_j^{negative} \, (1 - d_t^j) \, Q_t^j + \varepsilon_t \quad (4)$$

The extended variance equation of a standard GARCH model is:

[8] The EGARCH model of Nelson (1991) has the particularity of having the logarithm of the standard deviation (σ_n^2) in the left side, leading to a positive conditional variance (See Equation 3). Accordingly, no constraints have be retained on the estimated parameters.

$$\sigma^2_{R_{k,t}} = \omega + \alpha\varepsilon^2_{t-1} + \beta\sigma^2_{R_{k,t-1}} + \sum_{j=1}^{J} \varphi_j^{positive}\, d_t^j Q_t^j + \sum_{j=1}^{J} \varphi_j^{negative}\,(1 - d_t^j)\, Q_t^j \quad (5)$$

The extended variance equation of the EGARCH model is:

$$Log\ \sigma^2_{R_{k,t}} = \omega + \alpha\big(|z_{t-1}| - E\,[|z_{t-1}|]\big) + \gamma_m + \beta\,(Log\ \sigma^2_{R_{k,t-1}}) + \sum_{j=1}^{J} \varphi_j^{positive}\, d_t^j Q_t^j + \sum_{j=1}^{J} \varphi_j^{negative}\,(1 - d_t^j)\, Q_t^j \quad (6)$$

Instead of an ad-hoc selection of the models, we estimate the goodness of fit of each model by minimizing SIC (Beine and Laurent, 2003), while ensuring that no significant heteroscedasticity are left in the residuals. Such specification tests helps in optimizing the related estimators of GARCH-modelling. This step is particularly important, especially for the case of our data that depart from normality and exhibit volatility clustering.

3. Empirical results

Before presenting the results, it is worth noting that that GARCH(1,1) with GED distribution fitted the gold data best, whereas the best fitting model for Bitcoin data was the EGARCH(1,1) with normal distribution[9]. Importantly, the heteroscedasticity effect is now insignificant (see diagnostics checks in Tables 2-3).

3.1. Baseline results

We present here the empirical results of the baseline models, where we assumed no differential in the impact between positive and negative news surprises. Table 2 shows that the returns of gold (Bitcoin) are negatively affected by US (Euro Area) news surprises. Gold volatility is insensitive to news surprises, whereas Bitcoin volatility is affected by news surprises originated from the US, Euro Area, and Japan.

Table 2. The impact of macroeconomic news surprises on the returns and volatility of gold and Bitcoin prices

	Gold		Bitcoin	
Variable	Coefficient	P-value	Coefficient	P-value
Mean equation				
Constant	0.0156 (0.0180)	0.3883	0.6658 (0.0568)	0.0000
News _US	**-0.7853** (0.1537)	0.0000	0.1233 (0.1241)	0.8652
News _UK	-0.6753 (0.3773)	0.0735	-2.6325 (1.8610)	0.1567
News _Euro Area	0.2313 (0.2009)	0.2497	**-1.9267** (0.8289)	0.0200
News _Japan	-0.0863 (0.2556)	0.7356	1.4875 (1.4534)	0.2937
News _Canada	-0.0342 (0.2191)	0.8758	-0.7237 (1.2539)	0.5641
Variance Equation				
Constant	**0.0234** (0.0081)	0.0040	**-0.0437** (0.0179)	0.0000
ARCH	**0.0340** (0.0086)	0.0001	**0.4029** (0.0199)	0.0000
GARCH	**0.9442** (0.0127)	0.0000	**0.9331** (0.0055)	0.0000
EGARCH asymmetric term	**-**	-	**0.0479** (0.0112)	0.0000
News _US	-0.1601 (0.1423)	0.2607	**-0.6057** (0.1142)	0.0000

[9] We also considered the APGARCH (Tully and Lucey, 2007), but it wasn't the best fit in all cases. Importantly, the overall estimated results were qualitatively the same.

News _UK	0.4987 (0.0033)	0.1309	-0.3371 (0.2271)	0.1372
News _Euro Area	-0.0776 (0.1895)	0.6822	**1.3137** (0.1081)	0.0000
News _Japan	-0.0435 (0.2409)	0.8568	**1.3722** (0.2097)	0.0000
News _Canada	-0.1174 (0.1703)	0.4906	-0.1863 (0.1835)	0.3098
GED parameter	**1.0716**	0.0000	**-**	-
Diagnostic checks				
LM-ARCH (10)	1.5938		0.5431	
LM-ARCH (20)	0.9570		0.8009	
LM-ARCH (30)	0.7730		0.6578	

Notes: This table provides the estimated results from the baseline models given in Equations 1-3. Specifically, we consider the effect of macroeconomic news surprises on the returns and volatility of Bitcoin and gold. LM-ARCH statistics are for the Lagrange Multiplier heteroscedasticity test of Engle under the null hypothesis of no ARCH effects at lags 10, 20, and 30. Figures in bold are significant at 5% level. Values between parentheses are standard errors. Number of observations after adjustments is 1710.

3.2. Extended results

To uncover more nuanced results, we consider the differential or asymmetric response of returns and volatility to positive versus negative news surprises (Equations 4-6), and report the results in Table 3. Gold returns are negatively affected by positive macroeconomic news surprises from the US and the UK, while they are positively affected by negative macroeconomic news surprises from the Euro Area. Such evidence of an inverse relation between the sign of news and gold returns is in line with Caporale et al. (2017) and supports the safe-haven property of gold (Smales and Yang, 2015). Regarding the effect on volatility, positive (negative) macroeconomic news surprises from the five countries under studies decrease (increase) the volatility of gold price, except for the case of the UK where the effect of positive changes is insignificant. This overall finding provides evidence on the negative impact of positive macroeconomic news surprises on the volatility of gold, confirming its safe-haven role (Baur, 2012). The evidence of asymmetry, i.e. gold shows larger reaction to positive news surprises, is in line with Elder et al. (2012) and Smales and Yang (2015).

Regarding Bitcoin, it appears that positive macroeconomic news surprises originated from the UK decrease Bitcoin returns, confirming its safe-haven role in the UK. Further results show that positive news surprises originated from the Euro Area and Japan increase Bitcoin price volatility, whereas negative news surprises from the US decrease Bitcoin price volatility. These findings contradict the safe-haven hypothesis and some prior findings (Dyhrberg, 2016; Bouri et al., 2017a, b), indicating that Bitcoin generally behaves more like a risky asset than a safe-haven asset. However, an exception is for Japan, where it seems that the volatility of gold and Bitcoin share the same safe-haven behavior toward negative news.

Notably, the overall differences in the results between Table 2 and Table 3 were probably caused by positive surprises and negative surprises cancelling each other. This confirms the importance of splitting macroeconomic news surprises originating from large developed economies into positive and negative components in explaining some of the returns and volatility of gold and Bitcoin prices. Our analyses show an asymmetric impact on the returns and volatility of gold and Bitcoin, and that the impact of news surprises (both negative and positive) is stronger for gold. Importantly, we confirm the safe-haven role of gold (Baur and Lucey, 2010; Baur, 2012) with a different data and analyses, and reveal that Bitcoin is different from gold, with returns and volatility reacting to macroeconomic news surprises in a manner not consistent with a safe-haven. For practitioners and investors, our findings imply evidence of predictability for gold returns and volatility based on positive/negative macroeconomic news surprises and suggest that ignoring macroeconomic news surprises would undermine predictability, which is not necessarily the case for Bitcoin. Accordingly, the markets of gold

and Bitcoin don't share the same fundamentals. As argued by prior studies, the Bitcoin market is weakly related to macro- developments (Ciaian et al., 2016), but more dependent on market forces, Bitcoin attractiveness (Kristoufek, 2015; Ciaian et al., 2016) and technological factors (Yelowitz and Wilson, 2015).

Table 3. The impact of positive versus negative macroeconomic news surprises on the returns and volatility of gold and Bitcoin prices

	Gold		Bitcoin	
Variable	Coefficient	P-value	Coefficient	P-value
Mean equation				
Constant	-0.0154 (0.0234)	0.5273	**0.6689** (0.0851)	0.0000
Positive news _US	**-1.1738** (0.1815)	0.0000	-0.9197 (1.1603)	0.4280
Negative news _US	**-1.1281** (0.3023)	0.0002	-0.2676 (1.7557)	0.8788
Positive news _UK	**-2.5253** (0.7732)	0.0019	**-8.3007** (3.1812)	0.0092
Negative news _UK	-0.7564 (0.4728)	0.2988	0.0460 (3.3951)	0.9892
Positive news _Euro Area	0.2683 (0.4063)	0.4993	-2.3158 (2.2425)	0.3018
Negative news _ Euro Area	**1.3591** (0.3820)	0.0002	-1.1295 (1.7881)	0.5276
Positive news _Japan	0.6474 (0.6363)	0.3076	2.3508 (1.8730)	0.2094
Negative news _Japan	-0.3665 (0.2899)	0.2376	0.9704 (1.5292)	0.5257
Positive news _Canada	-0.1985 (0.3132)	0.6090	-0.5081 (1.2098)	0.6745
Negative news _Canada	-0.0602 (0.4308)	0.8974	-0.4296 (2.4374)	0.8601
Variance Equation				
Constant	**0.7572** (0.0387)	0.0000	**-0.0734** (0.0200)	0.0003
ARCH	**0.1947** (0.0048)	0.0000	**0.3988** (0.0205)	0.0000
GARCH	**0.5848** (0.0185)	0.0000	**0.9250** (0.0063)	0.0000
EGARCH asymmetric term	**-**	-	**0.0514** (0.0120)	0.0000
Positive news _US	**-1.8457** (0.1517)	0.0000	0.0509 (0.2261)	0.8223
Negative news _US	**1.0815** (0.2823)	0.0003	**-1.2230** (0.1812)	0.0000
Positive news _UK	0.9223 (0.9102)	0.3221	0.1513 (0.5062)	0.7649
Negative news _UK	**1.5352** (0.5664)	0.0700	-0.1416 (0.3872)	0.7146
Positive news _Euro Area	**-0.7936** (0.1071)	0.0000	**2.6913** (0.2188)	0.0000
Negative news _ Euro Area	**1.2240** (0.3998)	0.0013	-0.2013 (0.3231)	0.5333
Positive news _Japan	**-2.7311** (0.4059)	0.0000	**0.8065** (0.3541)	0.0227
Negative news _Japan	**2.2653** (0.1869)	0.0000	**1.4931** (0.3811)	0.0001
Positive news _Canada	**-1.3737** (0.2892)	0.0005	-0.3481 (0.2463)	0.1569
Negative news _Canada	**1.4703** (0.3806)	0.0014	0.1705 (0.3203)	0.5945
GED parameter	**4.0000**	0.0000	-	-
Diagnostic checks				
LM-ARCH (10)	1.3647		0.5599	
LM-ARCH (20)	1.4390		0.6278	
LM-ARCH (30)	1.2122		0.5023	

Notes: This table provides the estimated results from the extended models given in Equations 4-6. Specifically, we consider the effect of positive and negative macroeconomic news surprises on the returns and volatility of Bitcoin and gold. LM-ARCH statistics are for the Lagrange Multiplier heteroscedasticity test of Engle under the null hypothesis of no ARCH effects at lags 10, 20, and 30. Figures in bold are significant at 5% level. Values between parentheses are standard errors. Number of observations after adjustments is 1710.

4. Concluding remarks

We contributed to the debate on the similarities/dissimilarities between gold and Bitcoin markets by focusing on the asymmetric reaction of their returns and volatility to positive and negative macroeconomic news surprises originated from the US, Canada, the Euro Area, UK, and Japan. Using data recently constructed by Scotti (2016) and suitable GARCH-based models, our analyses show an asymmetric impact on the returns and volatility of both gold and Bitcoin. The impact of both negative and positive macroeconomic news surprises is stronger for gold than for Bitcoin. However, unlike Bitcoin, the nature of the impact on gold returns and volatility is consistent with gold's traditional role as a safe-haven.

A major limitation of our study is depicted by the coverage of Scotti (2016) data to developed economies, which forced us to ignore the impact of macroeconomic news surprises originating from large emerging economies (e.g. China, Russia, India), where Bitcoin and gold are used interchangeably to overcome the constraints imposed on capital flows. Future research should try overcome that limitation. Another limitation is related to the econometric approach used in this study, which is potentially subject to the omission of relevant variables such as short-term interest rates. Finally, inclusion of a jump measure would be an interesting extension to the employed methodology.

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