Do Bitcoin Stylized Facts Depend on Geopolitical Risk?

Messaoud Chibane[*]   Nathalie Janson [†]

Very Preliminary

January 31, 2020

ABSTRACT

We show that the dynamics of Bitcoin (BTC) price are strongly influenced by the level of global geopolitical risk. Indeed, a number of well established stylized facts about BTC cease to be true when we condition the evolution of BTC returns on the GPR index. In particular, we find that when geopolitical risk is high, BTC is no longer a perfect portfolio diversifier as it correlates strongly with Gold, US treasury yields and negatively with EUR/USD. We also find that BTC price bubbles are much more likely to occur when geopolitical risk is high, i.e. when investors flock to BTC as a digital safe haven or to a lesser extent when geopolitical risk is low and the BTC market behavior is speculative. Conversely, when geopolitical risk is moderate we find that BTC returns are approximately normally distributed and therefore do not seem to foster asset pricing bubbles. These results suggest that investors should adjust their portfolio holdings of BTC while adequately taking into account the amount of geopolitical risk present in the economy. Last, we find that the efficiency (in its weak form) of the BTC market increases with the level of geopolitical risk and that in fact the BTC market is rather efficient for moderate and high GPR.

JEL classification: G10; G11; G40; G41.

Keywords: Bitcoin; Geopolitical Risk; Hedging; Diversification; Bubbles.

[*]NEOMA Business School, France. messaoud.chibane@neoma-bs.fr
[†]NEOMA Business School, France. nathalie.janson@neoma-bs.fr

I. Introduction

Cryptocurrencies at large and Bitcoin (BTC) in particular, have attracted increasing academic attention since its end of year 2017 bubble. BTC was born in 2009 and despite its short and hectic life (witnessing 2 crashes in 2013 and 2018) it is still gaining in visibility. Given its current capitalization, the BTC market, approximately worth 170 Billion USD, looks pale in comparison to the 1.7 trillion USD in circulation. Nonetheless, it kept attracting new investors when in 2017, its price surged from 1000 USD in January to almost 20000 USD in December of the same year. Then, it kept falling throughout 2018 reaching its lowest point in November below 4000 USD. Since April 2019, it bounced back to 10000 USD, partly boosted by the announcement of the Libra project, the Facebook cryptocurrency. Early literature focuses mostly on the BTC technicalities and investigates its role as an alternative currency such as in Yermack (2015) and Dwyer (2015). Later articles focus on BTC price formation as in Brandvold, Molnár, Vagstad, and Valstad (2015), the existence of BTC pricing bubbles as in Cheah and Fry (2015) or its market efficiency as in Kristoufek (2018) and Urquhart (2016). Since the 2017/18 bubble and the high volatility characterizing BTC's price, academic work has focused its attention on the role of BTC in the context of portfolio allocation. In particular, Dyhrberg (2016) investigates whether BTC acts as a hedge against adverse market moves, while Klein, Thu, and Walther (2018) studies the role of BTC as a safe haven. Bouri, Molnár, Azzi, Roubaud, and Hagfors (2017) argue that BTC is mostly a portfolio diversifier. Overall this specialized literature focuses extensively on the dynamical structure of BTC as an asset but pays little attention to its qualities as a currency. Indeed, the Bitcoin was born in early 2009 partly as a reaction to the financial crisis and was built on a strong political stand. Its core concept was to remove human decision from the money supply process so as to avoid currency manipulation. As a result, BTC has been designed as a decentralized currency relying on a protocol that insured a limited money supply. This design can be viewed as a version 3.0 of the monetarist golden rule, stating that the money supply growth rate should be fixed, thus avoiding political interferences. Moreover, as a

2

peer to peer medium of exchange, BTC provides fast, highly secured and low cost payment services. This high level of security, delivered by cryptographic rules, provides a transaction validation protocol by the means of a proof of work. Consequently, trust is generated by the system itself in a decentralized manner, eliminating the need for a centralized authority such as private and central banks. Such a setting allows for BTC to become an alternative to the classic payment system and facilitates the transfer of money out of government sight. These services can be highly valued by individuals living in countries facing capital controls, capital restrictions and monetary or financial instability. Therefore, BTC comes across as a solution to circumvent government regulation and embeds a geopolitical dimension that makes it more than an asset. We argue that it is legitimate to question the extent to which geopolitical risk affects the true nature of BTC as an asset, a medium of exchange or a hedging device. To our knowledge, there are only few articles taking into account the geopolitical aspect of BTC in order to understand its price dynamics and its role in the market. Luther and Olson (2013)and Luther and Salter (2017) analyze the role of Bitcoin during periods of banking and monetary instability such as the Cyprus banking crisis and the European sovereign debt crisis. They show that despite BTC's high volatility, it represents a potential hedge against country-wise financial instability. In the context of Grexit, where capital controls were enforced, buying BTC was a solution to protect currency holdings from a potential devaluation whereas during the Cyprus banking crisis deposit accounts were exposed to potential losses since they were called to absorb the losses of Cyprus' banks. Buying BTC was perceived as a solution to protect depositors' belongings against expropriation. The same observations are made in Popper (2015) in the case of Argentina being plagued by galloping inflation and capital controls in the late years of Kirchner's government. Given that the official exchange rate was disconnected from the free market exchange rate (at the black market), Argentinians were using Bitcoin to overcome capital controls and take their money out of the country, thus avoiding exchange rate risk. Ju, Lu, and Tu (2016) investigates the use of the Bitcoin as a way to circumvent capital controls in China. More recently, Aysan, Demir, Gozgor, and Lau

(2019) analyzes the predictive power of geopolitical risk on BTC return and volatility. In a similar approach Demir, Gozgor, Lau, and Vigne (2018) analyzes the predictive power of economic policy uncertainty on daily BTC returns although it does not refer explicitly to geopolitical risk. Our contribution differs from the above mentioned articles as we do not focus on predictive aspects but rather on how geopolitics shape the structure and nature of the BTC market. To analyze the dynamics of BTC returns we condition its dynamics on the level of geopolitical risk as captured by the GPR index created by Caldara and Iacoviello (2018). Our results show that the nature of BTC changes with the level of the GPR index. Indeed, when geopolitical risk is moderate, BTC return do not seem to exhibit any pricing bubble while we can observe the characteristics of pricing bubbles when geopolitical risk is high. While BTC returns seem to have rather low correlation with most asset classes over-all, correlation with Gold returns and USD Yields increase substantially while correlation with EUR/USD and JPY/USD exchange rate changes substantially with geopolitical risk. Correlation with global equity markets seems to be rather low, regardless of GPR levels but correlation with emerging country shares seems to decrease significantly when geopolitical risk is moderate. Last, we show that as the GPR index increases the BTC market becomes more efficient in the weak sense. This work is organized as follows: in Section II we describe the data and methodology to characterize the interaction between BTC, equity, US government debt, gold and exchange rate while taking account geopolitical risk. Section III describes our empirical results as to how geopolitical risks change the dynamics of BTC returns. The last section concludes.

II.   Data and Methodology

We analyze the interaction of BTC with other markets by considering various types of asset classes. To represent Equity we consider two indices: MSCI World and MSCI Emerging. For Fixed Income instruments we choose US government debt for maturity 1

4

month, 1 year, 5 year and 10 year maturities. Since BTC is often compared to Gold we also consider Gold returns in our analysis. Last, we analyze the interaction of BTC with the EUR/USD and JPY/USD exchange rate. We note for the sake of intuition our exchange rates are quoted in number of US dollars for one unit of risky currency (EUR or JPY). All our data are extracted from the investing.com web site and to avoid de-correlation due to high frequency sampling effects we consider weekly returns instead of daily returns. Our data span the period [5 May 2013, 2 June 2019]. To capture the level of global geopolitical risk we use the GPR index of Caldara and Iacoviello (2018). This monthly index is constructed by counting the number words expressing geopolitical tension in 11 major international newspapers. We rank the level of geopolitical risk by constructing three tertiles for the GPR index each corresponding to: low (1st tertile), moderate (2nd tertile) and high geopolitical risk (3rd tertile). Because the GPR index and the returns used in our study run on a different frequency (monthly versus weekly respectively) we assign the value of the index computed at the beginning of the month to the rest of the month. In this study we wish to see how various characteristics of BTC dynamics change with the geopolitical context. In particular we are focus on how geopolitical risk impacts the tail behavior of BTC return as well as how BTC returns correlates to other asset classes. We also question whether the global geopolitical context affects the market efficiency of BTC. Before we answer this question we first establish a baseline by examining all these characteristics unconditionally, that is without taking into account the global geopolitical context. First, we display the full sample statistics of all assets returns in Table I.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
Mean	2.34	-0.01	0.11	0.01	16.02	1.46	0.49	0.15	0.05	0.04
Stdev	15.20	1.87	1.65	2.21	94.00	10.94	6.47	4.49	1.12	1.31
Skewness	2.13	-0.04	-0.56	-0.06	3.91	1.54	1.28	1.05	0.31	-0.19
Excess kurtosis	13.54	1.30	1.28	0.51	25.29	5.82	4.98	2.72	0.83	1.19

Table I Full sample return statistics

This table displays the weekly returns four first cumulants for Bitcoin, GOLD, MSCI World and Emerging indices, USD bond yields, EUR/USD and JPY/USD exchange rates. MSCI W stands for MSCI World and MSCI E for MSCI Emerging. Statistics are calculated over the full sample. Mean and standard deviations are expressed in percentages.

Our results based on weekly returns are consistent with previous literature where it is established that BTC returns show extremely high mean return (2.3% per week) and standard deviation (15.20%). By contrast the weekly mean of the MSCI World is 0.11% and its volatility is 1.65%. By and large, on the full sample, all assets and exchange rates have weekly means well under 1% and volatility under 3%. US treasury yields exhibit weekly volatilities ranging from 4.49% (10 years) to 94% (1 month). The full sample shows that BTC returns also displays a very high positive skew (2.13) and excess kurtosis of (13.54). Except for the 1 month yield, BTC skewness and kurtosis are well above other assets', indicating a clear deviation from the normal distribution.

We now look at the unconditional correlations between the different assets on the full sample. We display the results in Table II.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
BTC										
GLD	0.01									
MSCI W	0.01	-0.02								
MSCI E	-0.02	0.15***	0.79***							
1M US	-0.03	-0.04	-0.08	-0.09						
1Y US	0.08	-0.22***	0.02	-0.06	0.06					
5Y US	-	-0.41***	0.18***	0.02	-0.03	0.47***				
10Y US	0.01	-0.41***	0.17***	0.02	-0.03	0.43***	0.95***			
EUR/USD	-0.04	-0.39***	-0.03	-0.10*	0.02	0.07	0.29***	0.24***		
USD/JPY	-0.06	0.53***	-0.27***	-0.09*	0.04	-0.26***	-0.58***	-0.58***	-0.46***	

Table II Full sample correlations

This table displays the correlation matrix between BTC, GOLD MSCI Equity indices, USD bond yields, EUR/USD and JPY/USD exchange rates. Correlations are calculated over the full sample. *, ** and *** denote statistical significance at 10 percent, 5 percent and 1 percent levels, respectively.

In line with Briere, Oosterlinck, and Szafarz (2015) and Baur, Dimpfl, and Kuck (2018) we can see that BTC is virtually uncorrelated with all assets. The most surprising fact is that correlation between BTC and Gold is 1%, which is quite surprising considering the fact that BTC is conventionally perceived as "Digital Gold" (Popper (2015)). Based on this low correlation feature, Briere et al. (2015) show that including BTC drastically improves the risk-reward trade-off of a well diversified portfolio.

Finally we check for the presence for auto-correlation in BTC returns by performing a Ljung-Box test on BTC returns over the full sample and for various lags, ranging from 15

to 25. In Table III we display the p-value of the Ljung-Box Q statistic for these lags. We can see that for lags below 18, we reject the null hypothesis of an efficient BTC market at the 10% level but not at the 5%. For lags greater than 18, we fail to reject the BTC market efficiency hypothesis.

	15	16	17	18	19	20	21	22	23	24	25
Ljung Box p-value	8.08	10.65	9.05	11.15	13.72	16.27	16.20	19.92	19.24	19.80	18.98

Table III Full sample Test for Weak Efficiency

This table displays the results of Ljung-Box for weak efficiency for BTC returns. We display the p-value associated with the Ljung Box Q statistic for lags ranging from 15 to 25. p-values are displayed in percentages.

We now address the question of whether the characteristics of BTC returns are affected by the global geopolitical context.

III. Empirical results

A. Impact of geopolitical risk on BTC return distribution

The question we ask is whether these cumulants are going to change with the level of geopolitical risk. To this effect, we compute the first four cumulants of all asset returns while conditioning on the level of political risk. We display the results in Tables IV,V and VI respectively for low, moderate and high GPR.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
Mean	2.04	0.10	0.09	-0.11	22.78	1.75	1.20	0.74	-0.01	-0.02
Stdev	17.28	2.23	1.76	2.48	121.72	12.16	7.73	5.00	1.35	1.50
Skewness	1.54	0.15	-0.38	0.07	3.50	0.68	1.26	0.71	0.30	-0.50
Excess kurtosis	6.32	0.94	1.33	0.71	16.43	0.82	4.14	0.99	0.20	0.59

Table IV Return statistics conditioned on low geopolitical risk

This table displays the returns four first cumulants for Bitcoin, GOLD MSCI Equity indices, USD bond yields, EUR/USD and JPY/USD exchange rates where returns are conditioned on a low value of the GPR index at the beginning of observation period. Mean and standard deviations are expressed in percentages.

Many of these results are striking. Firstly, in moderate GPR, BTC returns exhibit exhibiting little skewness and little excess kurtosis. Conversely, in low and high GPR skewness

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
Mean	3.04	0.03	0.20	0.17	16.19	1.25	0.06	-0.15	0.10	0.09
Stdev	11.73	1.82	1.50	2.03	95.19	11.67	6.97	5.15	1.07	1.39
Skewness	0.36	-0.31	-0.67	-0.30	3.26	2.34	1.20	1.33	0.82	0.19
Excess kurtosis	0.46	0.71	2.28	0.64	22.44	10.57	3.16	3.13	0.96	1.20

Table V Return statistics conditioned on moderate geopolitical risk

This table displays the returns four first cumulants for Bitcoin, GOLD MSCI Equity indices, USD bond yields, EUR/USD and USD/JPY exchange rates where returns are conditioned on a moderate value of the GPR index at the beginning of observation period. Mean and standard deviations are expressed in percentages.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
Mean	1.94	-0.16	0.05	-0.02	9.09	1.38	0.22	-0.13	0.07	0.04
Stdev	16.13	1.48	1.69	2.12	51.99	8.78	4.15	2.98	0.88	1.00
Skewness	3.51	-0.49	-0.65	0.03	4.38	1.86	0.38	0.39	-0.42	-0.05
Excess kurtosis	23.79	0.86	0.38	-0.26	24.00	5.53	1.33	-0.13	0.54	0.10

Table VI Return statistics conditioned on high geopolitical risk

This table displays the returns four first cumulants for Bitcoin, GOLD MSCI Equity indices, USD bond yields, EUR/USD and USD/JPY exchange rates where returns are conditioned on a h value of the GPR index at the beginning of observation period. Mean and standard deviations are expressed in percentages.

and excess kurtosis increase and the phenomenon is even more pronounced for high GPR with an excess kurtosis of 25. Hence, in time of high geopolitical risk we can conjecture that investors flock into BTC, pushing its price up for the most part and generating a lot of extreme movements, hence explaining the high values of skewness and kurtosis. In time of low geopolitical risk, investor do not see BTC as a refuge but more as a speculation vehicle where speculators behave irrationally generating moderately high skewness and kurtosis as well as high volatility. In moderate GPR regime, BTC behaves more like a mainstream asset with less exuberance around it, thereby generating less volatility, skewness and kurtosis. By contrast all other assets are not affected as much by the level of geopolitical risk. We now turn to analyzing the impact of geopolitical risk on correlation.

B. *Impact of geopolitical risk on BTC correlation to other assets*

In Tables VII, VIII and IX we display the correlation of BTC returns to the remaining assets. One can see that the correlation between BTC and Gold is negative when GPR is low and moderate. However this correlation jumps to $21,5\%$ and significant at the % level when GPR is high, indicating this correlation is highly state dependent and that both

assets perform as safe havens when geopolitical risk is high. Interestingly, regardless of GPR level, correlation between BTC and MSCI world stays close to zero, confirming the unconditional statement that BTC is mostly de-correlated to equity markets conditionally as well. This statement does not hold when we look at the correlation between BTC and Emerging equity markets since in moderate GPR the correlation becomes negative $(-13, 0\%)$ and is significant at the 5% level. This could be interpreted as people seeking refuge in BTC when they lose confidence in their own emerging equity market, hence generating negative correlation between BTC and emerging market stock returns. Interestingly, the correlation between BTC and USD Bond Yields is small in low and moderate GPR but jumps to positive levels in high GPR. Indeed, correlation between BTC and 1 Year USD bond Yield is at 21.5% in high GPR while it is essentially 0% in moderate GPR. This means that in this configuration US government bond prices fall when BTC prices increase, indicating that when geopolitical risk is high, if investors dont trust US Government bonds they will turn their attention to BTC. The same phenomenon can be observed with 5 year and 10 year USD Bond. However, in high GPR BTC and 1 month T-Bill seem uncorrelated. Last, we can also observe that correlation between BTC and EUR/USD moves from $1, 5\%$ to -13.7% when GPR changes from Low GPR to High GPR. This means that when geopolitical risk is high, when BTC return increases, USD appreciates relative to EUR, meaning that when fleeing to quality, investors flock both to BTC and USD. The opposite phenomenon can be seen w.r.t. JPY/USD. Indeed correlation between BTC returns and JPY/USD moves from -14% in low GPR (significant at the 5% level) to -3% in high GPR.

In the next subsection we analyze the conditional efficiency of the BTC market.

C. *Impact of geopolitical risk on BTC market weak efficiency*

In Tables X we display the p-value of the Ljung-Box statistic for low, moderate and high geopolitical risk for lags ranging from 15 to 25. We can see that in high geopolitical risk the p-value is always large and we fail to reject the hypothesis of an efficient BTC market.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
BTC										
GLD	-0.09									
MSCI W	0.04	0.14**								
MSCI E	0.02	0.23***	0.85***							
1M US	-0.01	-0.02	-0.12**	-0.12**						
1Y US	0.04	-0.16***	-0.08	-0.07	-0.05					
5Y US	-0.06	-0.42***	-0.01	-0.11**	-0.09	0.39***				
10Y US	-0.07	-0.44***	-0.01	-0.08	-0.07	0.37***	0.94***			
EUR/USD	0.01	-0.51***	-0.08	-0.16***	-	0.11*	0.30***	0.28***		
USD/JPY	-0.14**	0.55***	-0.13**	0.02	0.11*	-0.21***	-0.53***	-0.53***	-0.52***	

Table VII Correlations conditioned on low geopolitical risk

This table displays the correlation matrix between the returns of BTC, GOLD MSCI Equity indices, USD bond yields, EUR/USD and USD/JPY exchange rates where returns are conditioned on a low value of the GPR index at the beginning of observation period. *, ** and *** denote statistical significance at 10 percent, 5 percent and 1 percent levels, respectively.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
BTC										
GLD	-0.06									
MSCI W	-0.03	-0.12**								
MSCI E	-0.13**	0.18***	0.73***							
1M US	-0.09	-0.08	-0.07	-0.11**						
1Y US	0.01	-0.33***	0.13**	-0.02	0.17***					
5Y US	0.01	-0.42***	0.36***	0.07	-0.01	0.58***				
10Y US	0.04	-0.43***	0.30***	0.04	-0.01	0.51***	0.96***			
EUR/USD	-0.05	-0.21***	0.07	-	-0.03		0.28***	0.21***		
USD/JPY	0.03	0.52***	-0.37***	-0.12**	-0.03	-0.30***	-0.64***	-0.62***	-0.43***	

Table VIII Correlations conditioned on moderate geopolitical risk

This table displays the correlation matrix between the returns of BTC, GOLD MSCI Equity indices, USD bond yields, EUR/USD and USD/JPY exchange rates where returns are conditioned on a moderate value of the GPR index at the beginning of observation period. *, ** and *** denote statistical significance at 10 percent, 5 percent and 1 percent levels, respectively.

	BTC	GLD	MSCI W	MSCI E	1M US	1Y US	5Y US	10Y US	EUR/USD	USD/JPY
BTC										
GLD	0.21***									
MSCI W	0.01	-0.17***								
MSCI E	-0.01	-0.01	0.78***							
1M US	0.01	-0.07	-	-						
1Y US	0.21***	-0.18***	0.03	-0.08	0.14**					
5Y US	0.12**	-0.40***	0.31***	0.22***	0.11**	0.46***				
10Y US	0.12**	-0.36***	0.34***	0.22***	0.04	0.39***	0.93***			
EUR/USD	-0.14**	-0.41***	-0.06	-0.11*	0.21***	0.10*	0.30***	0.25***		
USD/JPY	-0.03	0.53***	-0.39***	-0.26***	-0.03	-0.29***	-0.60***	-0.62***	-0.39***	

Table IX Correlations conditioned on high geopolitical risk

This table displays the correlation matrix between the returns of BTC, GOLD MSCI Equity indices, USD bond yields, EUR/USD and USD/JPY exchange rates where returns are conditioned on a high value of the GPR index at the beginning of observation period. *, ** and *** denote statistical significance at 10 percent, 5 percent and 1 percent levels, respectively.

10

This may be due to the fact that a high number of investors enter the BTC market in time of high geopolitical risk, thereby helping the market to be more efficient. In low GPR we can see that for all lags, the p-value is well under 1% enabling us to reject the hypothesis of efficient markets in low GPR. This could be due to the inverse phenomenon where in low GPR environments the number of market participants is much lower, making the market more inefficient. Last in a moderate GPR environment, we see that the p-value of the test is between $11,9\%$ and $25,9\%$ so that we also reject the null hypothesis of market efficiency at the 10% confidence level, albeit less strongly than in the high GPR environment. Consequently our results seem to establish clearly that the efficiency of BTC markets consistently increases with the level of geopolitical risk.

	15	16	17	18	19	20	21	22	23	24	25
Ljung Box *p*-value low GPR	0.14	0.09	0.11	0.11	0.16	0.25	0.20	0.25	0.27	0.39	0.54
Ljung Box *p*-value medium GPR	24.38	12.84	12.47	15.87	18.02	11.89	14.06	17.55	21.50	25.89	20.49
Ljung Box *p*-value high GPR	49.64	56.97	62.95	62.10	67.74	73.22	77.32	79.28	80.74	77.82	79.45

Table X Test for Weak Efficiency conditioned on geopolitical risk

This table displays the results of Ljung-Box for weak efficiency for BTC for low, moderate and high levels of geopolitical risk. We display the *p*-value associated with the Ljung Box Q statistic for lags ranging from 15 to 25. *p*-values are displayed in percentages.

We thus can see that geopolitical risk seems to impact substantially the dynamics of BTC as well as its market efficiency. Such sensitivity leads to think that the geopolitical context may have a significant impact on the decisions of a portfolio manager willing to consider BTC as part of her investment opportunities. We investigate this impact in the next section.

IV. Portfolio choice implications

In this section we consider the portfolio choice of a mean-variance investor who wishes to use BTC as part of his investment opportunity set. To do so we compare what would her portfolio holdings be, depending on whether the investor makes his investment decision without taking into account the geopolitical context or not. We assume that the investment

11

set is made of the following assets: BTC, Gold, MSCI World, MSCI Emerging, USD/EUR, USD/JPY. We assume that the investor exhibits a relative risk aversion of 10. We recall that the portfolio holdings in risky assets of such investors are given by:

$$\Pi = \frac{1}{\gamma}\Sigma^{-1}\left(\mu - r_f \mathbf{1}\right)$$

where Π is a (6x1) vector representing the portfolio holdings in risky assets, γ denotes the coefficient of relative risk aversion, Σ is the (6x6) covariance matrix between the risky assets, μ is a (6x1) vector of risk assets' expected returns, r_f is the risk-free rate and $\mathbf{1}$ is a (6x1) unit vector. The risk-free rate is computed as the mean one-month treasury bill return on the sample period. We display the results of this analysis in XI. Careful inspection of how portfolio holdings vary with the level of geopolitical risk reveals that investment in BTC is substantially higher when GPR is moderate. Indeed the mean-variance investor should allocate 23% of her wealth to BTC when GPR is moderate while this portfolio weight should be 10% when geopolitical risk is not taken into account. Interestingly, the holdings of GOLD is at its highest at 39% for moderate GPR. Surprisingly when GPR is high, holdings of both BTC and GOLD decrease but the investor should still hold a long position in BTC but a short position in GOLD. Furthermore, the mean-variance investor decreases his aggregate holdings of stocks (combined MSCI W and MSCI Emerging stocks) with geopolitical risk. Conversely, the mean-variance investor increases his aggregate holdings EUR and JPY currencies, thus confirming their roles as risk off currencies.

	BTC	GLD	MSCI W	MSCI E	EUR/USD	USD/JPY
Unconditional	0.10	0.07	1.08	-0.56	0.62	0.39
Low GPR	0.07	0.24	2.04	-1.47	0.17	0.52
Moderate GPR	0.23	0.39	0.85	0.05	0.94	-0.09
High GPR	0.10	-1.07	0.39	-0.17	0.76	0.93

Table XI Impact of geopolitical risk on portfolio holdings
This table displays the portfolio holdings in risky assets of a mean-variance investor low, moderate and high levels of geopolitical risk and for the standard (unconditional) mean-variance strategy. We use a value of 10 for the coefficient of relative risk aversion.

V. Conclusion

We have established that BTC dynamics are highly related to global geopolitical risk. Whether BTC returns behave like a normal distribution or a heavy tailed one depends on the GPR index level. Not surprisingly, the geopolitical context determines the nature of BTC as an asset, whether it is a safe heaven similar to Gold, a speculative vehicle or just another normally behaved one. We may ask whether our findings are also valid with other cryptocurrencies such as Ether or Ripple. Furthermore, we can't help noting that the GPR index aggregates a diversity of international signals. Hence, a natural extension of our research would consist in analyzing whether country specific GPR indices would be more influential than others in gearing the structure of BTC dynamics. Last, we establish that GPR substantially impacts the portfolio allocation of rational mean-variance investors who monitor geopolitical risk as part of their decision process. For this investor, BTC seems to behave like a hedge against geopolitical risk, surprisingly more than GOLD which should be shorted when GPR is at its highest.

REFERENCES

Aysan, A. F., E. Demir, G. Gozgor, and C. K. M. Lau (2019). Effects of the geopolitical risks on bitcoin returns and volatility. *Research in International Business and Finance 47*, 511–518.

Baur, D. G., T. Dimpfl, and K. Kuck (2018). Bitcoin, gold and the us dollar–a replication and extension. *Finance Research Letters 25*, 103–110.

Bouri, E., P. Molnár, G. Azzi, D. Roubaud, and L. I. Hagfors (2017). On the hedge and safe haven properties of bitcoin: Is it really more than a diversifier? *Finance Research Letters 20*, 192–198.

Brandvold, M., P. Molnár, K. Vagstad, and O. C. A. Valstad (2015). Price discovery on bitcoin exchanges. *Journal of International Financial Markets, Institutions and Money 36*, 18–35.

Briere, M., K. Oosterlinck, and A. Szafarz (2015). Virtual currency, tangible return: Portfolio diversification with bitcoin. *Journal of Asset Management 16*(6), 365–373.

Caldara, D. and M. Iacoviello (2018). Measuring geopolitical risk. *FRB International Finance Discussion Paper* (1222).

Cheah, E.-T. and J. Fry (2015). Speculative bubbles in bitcoin markets? an empirical investigation into the fundamental value of bitcoin. *Economics Letters 130*, 32–36.

Demir, E., G. Gozgor, C. K. M. Lau, and S. A. Vigne (2018). Does economic policy uncertainty predict the bitcoin returns? an empirical investigation. *Finance Research Letters 26*, 145–149.

Dwyer, G. P. (2015). The economics of bitcoin and similar private digital currencies. *Journal of Financial Stability 17*, 81–91.

Dyhrberg, A. H. (2016). Bitcoin, gold and the dollar–a garch volatility analysis. *Finance Research Letters 16*, 85–92.

Ju, L., T. Lu, and Z. Tu (2016). Capital flight and bitcoin regulation. *International Review of Finance 16*(3), 445–455.

Klein, T., H. P. Thu, and T. Walther (2018). Bitcoin is not the new gold–a comparison of volatility, correlation, and portfolio performance. *International Review of Financial Analysis 59*, 105–116.

Kristoufek, L. (2018). On bitcoin markets (in) efficiency and its evolution. *Physica A: Statistical Mechanics and its Applications 503*, 257–262.

Luther, W. J. and J. Olson (2013). Bitcoin is memory. *Journal of Prices & Markets 3*(3), 2015.

Luther, W. J. and A. W. Salter (2017). Bitcoin and the bailout. *The Quarterly Review of Economics and Finance 66*, 50–56.

Popper, N. (2015). *Digital gold: The untold story of Bitcoin.* Penguin UK.

Urquhart, A. (2016). The inefficiency of bitcoin. *Economics Letters 148*, 80–82.

Yermack, D. (2015). Is bitcoin a real currency? an economic appraisal. In *Handbook of digital currency*, pp. 31–43. Elsevier.