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Bitcoin: competitor or complement to gold?

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Abstract

This study seeks to address whether Bitcoin ever match or even replace gold as a safe haven. To this end, we use a dynamic Markov-switching copula model to test the complementarity and substitutability among Bitcoin and gold within two risk scenarios (i.e., low- and high-risk regimes). Our results reveal a positive and strong correlation between gold and Bitcoin returns coinciding with specific economic and political events. Gold and Bitcoin benefit from the same economic conditions. This suggests that gold and Bitcoin are likely to be complementary, rather than in competition with each other. Gold could act as a diversifier for investors in digital assets. But the Bitcoin have a lot to teach gold in terms of the efficient transfer of value.

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1. Introduction

Bitcoin was created in 2008 in the middle of one of the worst financial crises in history. Bitcoin has shown great resilience during periods of turmoil, highlighting its potential hedging and safe haven abilities against global uncertainty. Bouri et al. (2017) claimed that the global uncertainty surrounding the 2008 global financial collapse eased the emergence of Bitcoin and strengthened its popularity as both a financial asset and an alternative currency to conventional economies. Luther and Salter (2017) indicated that attention towards Bitcoin rose remarkably following the announcement that Cyprus would accept a bailout on March 16, 2013. Bitcoin has also been reported in countries such as Greece, whose banks are troubled. Other recent studies have analyzed the role of Bitcoin as a hedge against various assets (Popper, 2015) and against commodities (Dyhrberg, 2016). Also, a large number of empirical researches documented the potential role of Bitcoin as an investment and underscore the diversification benefits of adding Bitcoin to an asset portfolio (for example, Brière et al. 2015; Eisl et al. 2015; Selmi et al. 2018a). This has logically led to a comparison between Bitcoin and gold, as gold is largely regarded, in theory, as a hedge and safe haven to protect against similar risks.

Even though the hedge and safe haven abilities of Bitcoin and gold are open to interpretation, having accurate information into the dynamic correlation between these two assets can help investors to construct an optimal portfolio. Some concerns like the existence of asymmetric or time-varying dependence may help to appropriately measuring and assessing risks. It is largely known that asset dynamics are hugely challenging as they inherently include stochastic and nonlinear components. The present research carries out a relatively new copula-based approach able to shed new light on the dynamic dependence between assets (in particular, gold and Bitcoin) under low- and high- risk scenarios. Specifically, we employ alternative modelling approaches based on studies that use copula classes and Markov-switching models. The copula models ease separate modeling of the marginal distributions and the dependence and therefore, a variety of dependence structures can be detected with more flexibility and parsimony. Throughout this paper, we apply a dynamic copula with Markov-switching to model the correlation between gold and Bitcoin return, and then to test for complementarity or substitution among these assets under different regimes. Positive correlation is interpreted as a complementary relationship, whereas negative correlation is interpreted as a substitute linkage. Such a flexible copula model enables to reproduce extreme return clustering and asymmetry by enabling for two time-varying dependence regimes, low or normal and high or crash, both at the center and tails of the bivariate distribution. This econometric tool seems appealing as the behavior of time series often appear to go through different phases. For investors wanting to use the gold and Bitcoin safe haven properties to safeguard against unforeseen events or crises, it is very useful to discover whether the gold and Bitcoin are complement or substitute across various states, or concentrated in specific times of turmoil.

Despite the arguments over gold's and Bitcoin' relative merits, our findings suggest that gold and Bitcoin can form part of an investment portfolio. Both assets may act as a safe haven in stressed times but for different reasons.

The remainder of the study is organized as follows: Section 2 introduces the data and describes the methodology. Section 3 reports and discusses the findings. Section 4 concludes and provides some risk management implications.

2. Methodology and data

The use of econometric approaches that acknowledge shifts in the dependence structure between gold and Bitcoin returns can be very useful and beneficial to limit systemic risks during high-risk market regimes. Throughout the present research, we employ a dynamic Markov-switching copula model which accommodates a flexible relationship among time series in each regime and hence, can capture regime-specific mean reversion.[1] This characteristic distinguiches this technique from conventional copulas and the standard switching regime models where a function is presumed to govern each regime despite how long the given state prevails. Following Fei et al. (2013) and to outline the dynamic copula with Markov-switching framework, let S_t be a state variable that represents the prevailing regime. The joint distribution of X_{1t} and X_{2t} conditional on being in regime s is expressed as follows :

$$(X_{1t}, X_{2t} \left| X_{1,t-1}, X_{2,t-1}; S_t = s) \approx C_t^{S_t} (\mu_{1t}, \mu_{2t} \right| \mu_{1,t-1}, \mu_{2,t-1}; \theta_t^{S_t}) \qquad (1)$$

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[1] The mean reversion is the theory indicating that prices eventually move back toward the mean or the average.

Where $s \in \{H, L\}$, H is the high dependence regime and L the low dependence regime. The random variable S_t follows a Markov chain of order one distinguished by the transition probability matrix denoted as :

$$\pi = \begin{pmatrix} \pi_{HH} & 1-\pi_{HH} \\ 1-\pi_{LL} & \pi_{LL} \end{pmatrix} \qquad (2)$$

Where π_{HH} and π_{LL} are the so-called staying probabilities, namely, π_{HH} (π_{LL}) is the probability of being in the high (low) dependence regime at time t conditional on being in the same regime at time t − 1.

Previously, Patton (2006) sets out the foundations for time-varying copulas by demonstrating Sklar's theorem for conditional distributions, and claimed that the generic copula dependence parameter θ evolves in ARMA fashion as follows which permits mean-reversion in dependence based on the forcing variable Γ_t.

$$\theta_t = \wedge(\omega + \varphi\theta_{t-1} + \psi\Gamma_t) \qquad (3)$$

The dynamic copula with Markov-switchingc onsists first to apply a regime-switching ARMA copula where the dependence structure evolves as follows :

$$\theta_t^{S_t} = \wedge(\omega^{S_t} + \varphi\theta_{t-1}^{S_{t-1}} + \psi\Gamma_t) \qquad (4)$$

where $\Lambda(\cdot)$ is the modified logistic or exponential function.

Thereafter, a regime-switching dependence model is carried out where the time-varying copula function that governs each regime is of DCC type expressed as follows :

$$Q_t^{S_t} = (1-\varphi^{S_t} + \psi^{S_t}\left|\overline{Q} + \varphi S_t Q_{t-1}^{S_{t-1}} + \psi^{S_t}\varepsilon_{t-1}\right. \qquad (5)$$

with $Q_t^{S_t}$ the auxiliary matrix determining the rank correlation dynamics, $\varphi^{S_t} + \psi^{S_t} \prec 1; \varphi^{S_t}, \psi^{S_t} \in (0,1)$. Note that the Gumbel copula is used to allow for time-variation in dependence and tail dependence within each regime. This would permit to capture sharp increases (decreases) in dependence in turbulent (tranquil) states without imposing the restriction of static within-regime dependence.

We consider daily price data for the Coin Desk Bitcoin Price Index and the gold price ranging from July 18, 2010 to March 31, 2018.[2] The Coin Desk Bitcoin Price Index represents an average of Bitcoin prices across leading Bitcoin exchanges, and therefore it detects global Bitcoin prices better than other alternatives (https://www.coindesk.com/price/bitcoin). The data for gold prices, which are measured in USD per ounce, were downloaded from the website of the Bank of England (https://fred.stlouisfed.org/series/GOLDAMGBD228NLBM).

Table 1 reports the descriptive statistics of the daily returns of the variables of gold and Bitcoin returns (GR and BTR, respectively). The mean returns are close to zero for all of the return series and appear moderate relative to the return standard deviations, which would mean no significant trend in the data. The standard deviation values indicate that Bitcoin is much more volatile than gold. The skewness coefficient of all the variables is negative and the kurtosis coefficients is above three, indicating that the probability distributions of the return series are skewed and leptokurtic, thereby rejecting normality. All the return series are non-normal as indicated by the Jarque-Bera test.

[2] The use of daily data enables to account for the adequate moment of each policy announcement and to evaluate the immediate market reaction to specific innovations (Pastor and Veronesi 2012). With high frequency data, we can set a narrow time window around each policy announcement and each unforeseen event to effectively address whether the markets responded to particular news.

Table 1. Descriptive statistics of return series

	GR	BTR
Mean	8.19E-05	0.0043
Median	-7.70E-05	-0.0001
Std. Dev.	2.0963	4.5634
Skewness	- 0.7559	-0.3195
Kurtosis	4.7995	6.7674
Jarque-Bera	34.729	59.949
p-value	0.0000	0.0000

Notes: Std. Dev. symbolizes the Standard Deviation; p-value corresponds to the test of normality based on the Jarque-Bera test.

The Pearson correlations of Bitcoin and gold returns are displayed in Table 2. We notice that, there is a positive and relatively moderate relationship between Bitcoin price changes and gold returns. Regardless of the relevance of this finding, the Pearson product-moment correlation coefficient is a measure of the strength of the linear dependence between time series. If the investigated relationship is nonlinear, then this correlation coefficient does not properly reflect the sign and the magnitude of the relationship under study.

Table 2. Pearson correlation of Bitcoin and gold returns

	BTR	GR
BTR	1	0.01172
GR	0.01172	1

We also assess the occurrence of nonlinearities in the considered time series using the BDS test (Brock et al., 1996) of nonlinearity on the residuals recovered from the OLS models. The outcomes are provided in Table 3. We show strong evidence of nonlinearity, as the null hypothesis of independent and identical distribution (i.i.d) is rejected. The results reveal that GR and BTR are non-linearly dependent, whichis one of the indications of a chaotic behavior and justify the appropriateness of dynamic Markov-switching copula for testing the complementarity or substitutability among gold and Bitcoin within different risk regimes.

Table 3. The BDS test based on the residuals of the return series

Dimensions	m=2	m=3	m=4	m=5	m=6
GR	5.228***	7.924***	9.591***	10.539***	11.513***
BTR	3.416**	5.083***	7.134***	8.169***	8.342***

Notes: *m* denotes the embedding dimension of the BDS test. *** and ** indicate the rejection of the null of the residuals being *iid* at the 1% and 5% levels of significance, respectively.

3. Empirical results

Table 4 summarizes the estimation results of the dynamic copula with Markov-switching model. The parameters ω_H and ω_L of dynamic copula with Markov-switching show that the level of dependence between Bitcoin and gold returns is positive and statistically significant in high-risk period (ω_H), while it appears insignificant in low-risk or normal states (ω_L). This confirms the complementary role that Bitcoin can play with gold, by allowing easy and secure transfers without physically moving the asset. The logical implication for investors and traders is that both Bitcoin and gold could be useful assets with which to diversify away the risk associated with heighetened uncertainty surrounding unforeseen events. Moreover, the persistence measures (φ and ψ) suggest that the rank correlation GR-BTR is persistent. The probabilities π_{HH} and π_{LL} consistently indicate long duration of the high dependence regime.

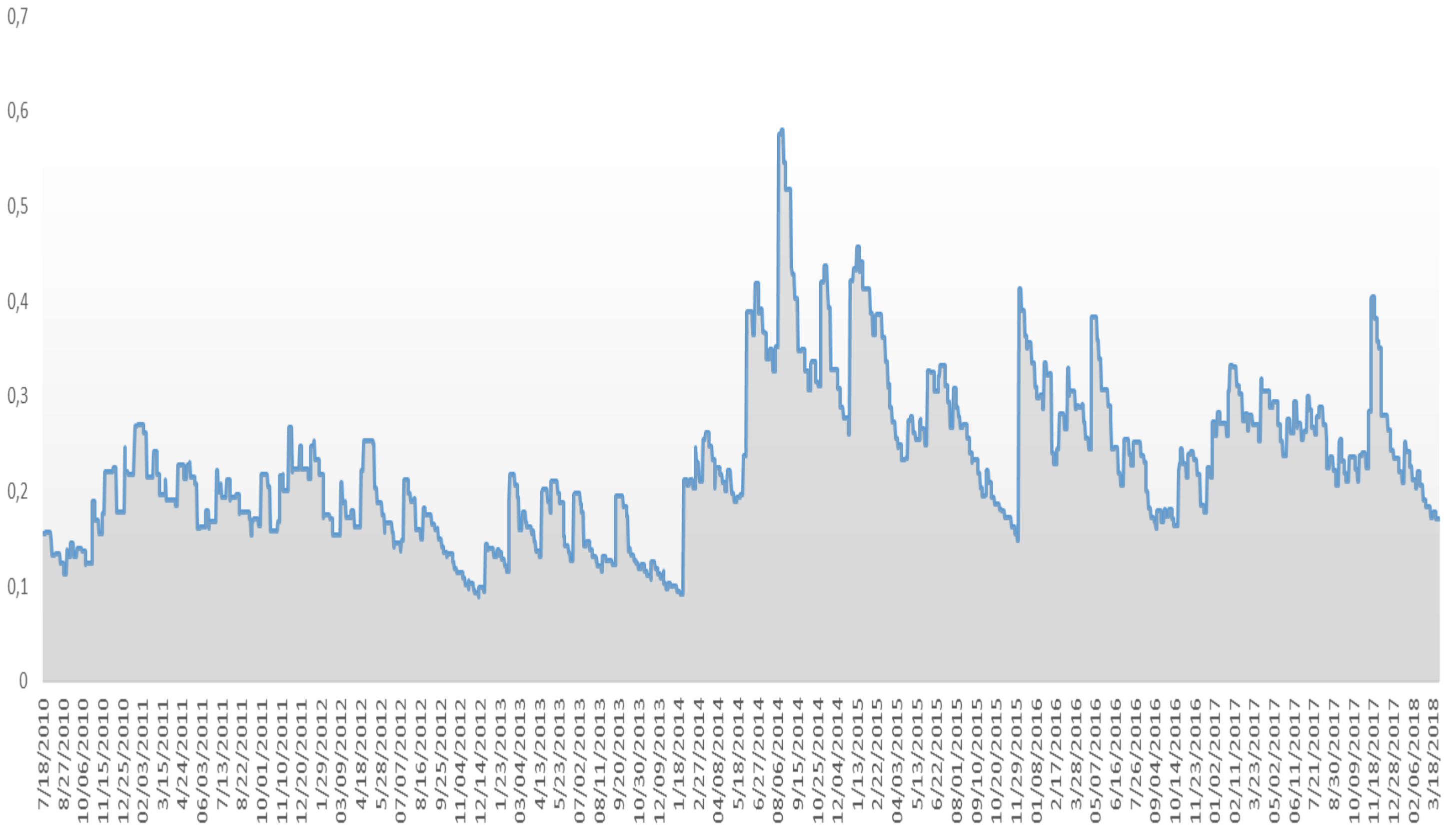
Table 4. The correlation between gold and Bitcoin returns: Estimation of the dynamic copula with Markov-switching model

	GR-BTR
ω_H	0.3619*** (0.0003)
ω_L	-0.0932 (0.2456)
φ	0.2209* (0.0146)
ψ	0.1371** (0.0059)
π_{HH}	0.8412*** (0.0003)
π_{LL}	0.1705** (0.0014)

Notes: Superscript *H (L)* indicates the high (low) dependence regime. π_{HH} (π_{LL}) is the probability of staying in the high (low) dependence regime; *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Figure 1 plots the Markov-switching correlation for Bitcoin and gold returns and reveals that the dependence structure changes over time. We note a positive correlation over the whole period, but this dependence appears much more pronounced in periods of market stress. A positive correlation between gold and Bitcoin returns coincide with economic and political events. In particular, the complementary relationship between gold and Bitcoin strengthens after the unprecedented bailout of Cyprus's banks (March 2013), the China's economic slowdown (since the fourth quarter of 2015), the Brexit vote (June 2016), the US presidential elections and India and Venezuela's demonetization (November 2016), and the announcement of Fed tightening (December 2016). Notably, the correlation between Bitcoin and gold returns is stronger after the great oil crash of 2014, the United States presidential inauguration (January 2017), and the escalation of trade policy tensions (since February 2018). The cumulative decline in oil prices between June and December 2014 alone was 44 percent. This has put severe economic stress on oil producers around the world. In addition, the election of Donald Trump and the associated events that happened in the run-up to his win in the presidential elections led to an unprecedented era of inconceivable uncertainties. Trump's economic plan focuses on 'making America great again' with some controversial policy propositions, such as threatening to leave the Trans-Pacific Partnership (TPP) trade deal, Paris agreement on climate change, UNESCO, The North American Free Trade Agreement (NAFTA), and the Joint Comprehensive Plan of Action (JCPOA) on the Iranian nuclear issue. Mr Trump also suggested contradictory policy measures including fiscal expansion, by spending more on defense and security sectors and infrastructure, and fiscal contraction by spending less on education and the environment. The threat of an uptick in trade tensions between the United States and China and the prospect of a rapid rise in U.S. interest rates have adversely affected the global stocks. Overall, all these factors combined exacerbated uncertainty that made financial markets greatly volatile. As a result, investors have flocked to safe-haven assets such as gold and Bitcoin to safeguard against falling oil and stock prices.

Figure 1. Markov-switching correlation coefficients



4. Conclusions

Will Bitcoin ever replace gold as a safe haven? This study answers this question by testing the complementarity and substitution among the two assets within low- and high-risk regimes. A positive and pronounced correlation between gold and Bitcoin returns is found during heightened risk periods.

This result can be explained by investors' high risk aversion during rising uncertainty episodes and readiness to shift back to more beneficial assets throughout a recovery in financial markets. Both gold and Bitcoin tend to be resilient during market crashes because they are negatively dependent on risky assets. Although stock markets benefit from stability, gold and Bitcoin benefit largely from market volatility. If risky assets collapse, worries increase, and investors typically seek out the safe haven features of gold and Bitcoin. By comparison with most other investment assets, gold and Bitcoin have the advantage of being free of counterparty risk: their perceived values are inherent, rather than relying on any other institution, such as a government, or central banks. When it comes to other attributes of desirable money, gold and Bitcoin seem to have dissimilar merits. Bitcoin is generally chosen as an attractive investment. Its extremely volatile and its speculative behavior enable investors and traders to earn supernormal returns in a short-time span (Selmi et al. 2018b). It also provides better divisibility than gold. Also, the introduction of futures would help tilt the scale a bit in the direction of Bitcoin. It would limit the risks associated to Bitcoin's lack of regulation. Nevertheless, the yellow metal has been viewed throughout civilization as an effective safe haven used to store value, and has never gone to zero in recorded history (Baur and Lucey, 2010). Besides, gold as a physical asset is protected by a strong property law which is proven and universally understood. Furthermore, units of gold may be more interchangeable than Bitcoin. In fact, gold is gold anywhere in the world, but the transparency of the Bitcoin blockchain could enable merchants to discriminate against certain coins on the basis of their past owners and/or transaction history. Despite these differences, we consistently find that both assets may serve as a safe haven in uncertain times but for distinct reasons. For Bitcoin, its limited supply and its growing popularity certainly raise its value. For gold, central banks, governments and individual investors would often perceive it as the ideal safe haven against uncertain exposure, which was traditionally its most common use (Bouoiyour et al. 2018). In brief, this article'outcomes suggest that gold and 'digital gold' can co-exist as safe haven investments, and then it is prominent to look at them as complements that diversify each other's portfolios rather than substitutes.

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