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# Bitcoin Hedging and Diversification Capabilities: An International Evidence

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## Abstract

Using daily data from 19 July 2010 to 11 July 2018, we find that the Bitcoin market can be regarded as a hedge on the one hand for the American dollar currency fluctuations and on the other hand for some stock index changes. Our overall results suggest that Bitcoin is the digital gold. Hence, it can be a useful tool for portfolio management and our results can help investors to make more informed decisions

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***Index terms***— bitcoin, hedging performance, univariate and multivariate garch models.

# 1 Introduction

ooking back in history from the internet and ecommerce to the virtual currencies we have enjoyed amazing advantages which changed our lives. Bitcoin, the famous crypto-currency since its launch after the financial crisis of 2008, has evolved the way we look at finance and our previous concepts to issue, store or transfer money. Despite the huge interest in Bitcoin as a digital asset, the current finance literature is still lacking empirical evidence on its hedging properties against other assets, in particular against major world equities. Indeed, this analysis will give detailed sight of the interaction of this new financial asset in the market and what place is has comparably to other assets. Bitcoin «... is a peer-to-peer digital currency that trades on public exchanges and can be instantly transferred between any two people or more anywhere in the world with the speed of an email and at far lower cost than for transactions processed through the traditional financial system. The bitcoin launching was based on a nine-page "Bitcoin: A Peer-to-Peer Electronic Cash System" unleashing the bitcoin software, all of it public, in January 2009. The system allowed for the creation of 21 million bitcoins, total, with the last ones to be released in 2140» (Debrova 2016). In this review, we will check Bitcoin from an economic view point. In this context, we note that this crypto-currency has compared to gold as they have many similarities: their primary values are given by their scarcity of supply, their supply is not controlled by any government, the both have high price volatility and their total supply is finite (Popper 2015, **??**yhrberg 2016). Likewise, the gold has known by its hedging capabilities against stocks, bonds and American dollar, to this, Bitcoin might exhibit similar correlations. This paper addresses two questions: first, we examine whether Bitcoin acts as a hedge against the American dollar, to see how well Bitcoin protected against currency fluctuations and second, if Bitcoin can acts as a hedge for major world stock index. Consequently, this paper will thereby be modeled after previous researches of gold using the same methodology and our findings can be compared to get a sense of the comparable hedging capabilities of gold and «digital gold» **??**Dyhrberg 2016). The rest of the paper is organized as follow. Section 2 presents the relevant literature. Section 3 introduces the data and the methodology. Section 4 discusses the empirical results. Section 5 concludes.

# 2 II.

# 3 Relevant Literature

When we talk about the literature related to the hedging capabilities of a financial asset, we refer to the one linked to gold. Many studies have examined the dynamic relationship between gold, American dollar and stocks such as the first study which officially tests if gold is a hedge or safe heaven was done by **??**aur Lin and al 2014 model a VAR-GARCH and DCC-GARCH models to investigate the volatility dynamics between equity prices and oil prices in Ghana and Nigeria. To study the volatility transmission between emerging market stock, copper, oil and wheat prices over the period 2000 to 2012. Sadorsky 2014a estimates a multivariate GARCH models. Sadorsky 2014b estimates a DCC and CCC-GARCH models to model volatility and conditional correlations between the Dow Jones equity, gold and oil prices. Bredin and al 2015 employ a wavelet analysis and show that gold can be a hedge up to a year. Dyhrberg 2016a investigates the hedging properties of Bitcoin against stocks and American dollar by a GJR-GARCH and concludes that Bitcoin can reduce specific market risks and it is uncorrelated to stocks. To analyze the relationship between gold and global uncertainty Bouri and al 2017a apply a quantile regression approach and found that Bitcoin can hedge against global uncertainty at short investment horizons. Bouri and al 2017b employ a DCC-model and show the evidence of the limited hedging and safe properties of Bitcoin, although it can still be an effective diversifier.

# 4 III. Data and Econometric Modeling

We used for this study a daily data series from 19/07/2010 to 11/07/2018. The closing prices for the Bitcoin coindesk index are sourced from coindesk.com. USD/EUR, USD/GBP, USD/CNY and USD/JPY exchange rates are from Federal Reserve economic data, as well as the five most famous market indexes: FTSE100, SP500, DAX30, HSI and CAC40 are sourced from yahoo-finance. We filter out Bitcoin prices during periods when the currency markets are closed, since Bitcoin trades 24-hours a day, 7-days a week. We employ logarithmic returns for Bitcoin and other series such that:

Where are the returns, is the price at time t and is the price at time t-1.The descriptive statistics of the returns are reported in table 1. Where we can see the Bitcoin has the largest return and all the other series have a positive ones, except that of Chinese Yuan. In panel A, the variable with the smallest mean return is HSI while the SP500 has the highest mean return. In panel B, USD/EUR exchange rate has the smallest mean return while the USD/JPY exchange rate has the highest one. According to the standard deviation values, the Ret-BTC in panel A and in panel B is the most volatile series. In addition, we observe that RET-BTC and RET-CNY in panel A and B respectively has the highest level of kurtosis, indicating that extreme changes tend to occur more frequently for stock prices and the Jarque-Bera statistics reject normality for all our variables. Following Baur and McDermott 2010, Hood and Malik 2013, Ratner and Chiu 2013 we differentiate between a diversifier and a hedge as follow: « a diversifier is an asset that has a weak positive correlation with another asset on average. A weak (strong) hedge is an asset that is uncorrelated (negatively correlated) with another asset on average». Furthermore, our methodology is based to some extent on Dyhrberg 2016 who estimates a univariate GARCH model (T-GARCH) to investigate the hedging effectiveness of Bitcoin against the American dollar and FTSE index, on Chen and Wang 2017 paper which examines the dynamic relationship between gold and stock market in China using a multivariate model (DCC-GARCH) and on Bhatia and al 2018 who apply a DCC-GARCH and to check the robustness of the relationship, they estimate an ADCC-GARCH model between crude oil and precious metals. model is estimated. In the second step, a time-varying correlation matrix is computed using the standardized residuals from the first-step estimation. However, for the purpose of this study the model is estimated separately for pairs of return series. In doing so, the minor possibility of getting biased estimates of parameters in higher dimensions is prevented **??**Hafner and Reznikova 2012). The mean equation of the DCC model is specified as:? = + ? ? BTC + ? ln ? + ? ? ? +**(2)**= 0 + 1 + + 0**(3)**? = + ? + ? + ? +**(4)**= 0 + 1 + + 0**(5)**

The residuals are modeled as:

Where is the conditional covariance matrix of is a n×1 i.i.d random vector of errors. All DCC class models (including the conditional correlation GARCH (CCC)) use the fact that can be decomposed as follow:

Where; is an n×n conditional covariance matrix, is the conditional correlation matrix, is the diagonal matrix with time varying standard deviations on the diagonal.

Where the expressions of h are the GARCH (1,1). For the univariate GARCH model the elements of are written as:

The symmetric positive definite matrix is modeled as:

# 5 Where is the n×n unconditional correlation matrix of the standardized residuals

The DCC model is mean reverting as long as $<1$. For the purposes of this paper, the focus of interest is the conditional correlations between the return of Bitcoin and return of each other series pair are calculated by: Capiello and al 2006 estimate the asymmetric DCC (ADCC) -GARCH model and the dynamic regression is given by: Where

) equal to 1 if <0 and equal to 0 otherwise. The asymmetric effect is designed to capture an often observed characteristics of financial assets that an expected fall in prices tend to increase volatility more than an expected increase in asset prices of the same magnitude meaning that bad news increases volatility more than good news and the dynamic of Q in this case are given by: Where A, B, G are n×n parameters matrix. are zero threshold standardized errors which are equal to when less than 1 and 0 otherwise. are the unconditional matrix of IV.

# 6 Empirical Results

# 7 Table 2 reports the cross-correlations between

Ret-BTC/Ret-variables for up to four lags. The most of coefficients are negative suggesting that Bitcoin can be used as a hedge against these assets. However, these correlations are very smalls, thus suggesting, that any dynamic relationship, if it exists, will be short lived. Capie and al 2005 found similar small negative values of correlations between the return on the yen dollar and sterling dollar exchange rates and the return on gold, proving the gold as the «anti-dollar». Next, by estimating the TGARCH we can verify in more details this relationship.

# 8 Table 2: Crosscorrelogram between Ret_Bitcoin and Ret_variables

? , = + , + ? ,**(10)**= (1 ? ? ) + + )**(11)**

, , = Table 3 suggests that Bitcoin has hedge ability against US dollar fluctuations as the contemporaneous effects and their lagged coefficients are insignificant, implying that these variables are uncorrelated on average, thus, the BTC is a weak hedge and has longterm hedge capabilities. The return on BTC is not affected by changes in the exchange rates which creates a possibility for investors to hedge some of the market risks. These results are similar to those of Capie and al 2005 though they get insignificant contemporaneous and lagged values, indicating that Bitcoin and gold have similar hedging capabilities against the American dollar. Next, we estimate the multivariate GARCH model of dynamic conditional correlations using maximum likelihood. Since the series in our dataset show some evidence of non-normality, the remedy here is to use the quasi maximum likelihood method (Bollerslev and al 1988) in order to generate consistent standard errors that are robust to non-normality. However, to account for non-normality in the distribution of returns the DCC-GARCH and ADCCGARCH was estimated with a multivariate t-student distribution. Table between BTC/DAX30 which means that they are correlated on average and the BTC is not a means of hedging against its fluctuations. fluctuations in long term. In addition, the contemporaneous effect is significant and positive implying that the BTC is a weak hedge against their Table 4 summarizes the results of the estimated models 4 and 5. In the mean equations, the contemporaneous effects of SP500, FTSE100, CAC40 and HSI and their lagged coefficients are insignificant; thus, these variables are uncorrelated on average The magnitude of mean dynamic conditional correlation coefficients varied between -1 and 1. If the coefficient was closer to -1, the negative correlation between Bitcoin and financial assets was stronger. In contrast, when the coefficient was closer to the positive correlation between Bitcoin and other series was stronger. If the coefficient was equal to 0, Bitcoin had no relationship with them. The mean dynamic conditional correlations between stock index, American dollar and Bitcoin are presented in Table 6. Since our results are almost similar1 in the two multivariate frameworks, we refer to the results obtained by DCC-GARCH in the following tables. The mean of dynamic conditional correlation between BTC/SP500, BTC/FTSE100 and BTC/DAX30 were all positive. This finding indicates that our crypto currency did not act as a hedge for American, German and U.K stock index. The mean of the other dynamic conditional correlation pairs varied between -0.01074421 and -0.00044505. Among them, in panel A the mean dynamic conditional correlation coefficient of BTC/CNY was the largest at -0.00158053 and the minimum mean dynamic conditional correlation coefficient was BTC/JPY, which was -0.00044505. In panel B, the coefficient of BTC/HIS was the largest at -0.01074421, and the minimum coefficient was BTC/CAC40, which was -0.00158689. This showed that Bitcoin could act as a hedge against their fluctuations. Bitcoin Hedging and Diversification Capabilities: an International Evidence information about the correlation dynamics, the summary statistics for the derived correlations are presented in Table 7.? , = + ? , + ( , ), **, , , , , , ? (13)**= ( ? ? ? ) + + +**(14)**

# 9 Variables

suggests that volatility estimates between Bitcoin and the other financial assets are not influenced by negative shocks or sharp increase in returns. To provide more correlation between BTC and USD/CNY (0.883) was the weakest. In panel B, the dynamic correlation between BTC and FTSE100 (0,326) was the weakest, while dynamic correlation between BTC and HSI (0,985) was the strongest. In the case of the ADCC model, the dynamic conditional correlations are also mean reverting. ADCC parameter estimate ( ) for asymmetric relationship is not statistically significant and panel A, the dynamic correlation between BTC and USD/GBP (0,977) was the strongest, while the dynamic 5 reports DCC and ADCC-GARCH parameter estimates. For the DCC model the estimated coefficients and sum is less than one, indicating that the dynamic conditional correlations are mean reverting. Thus, in

# 10 Variables

Symmetric The descriptive statistics of dynamic correlation coefficients (DCC) of each BTC-asset pairs are presented in Table 7. The statistics show that Bitcoin is 0.000778 positively correlated with DAX30 and on the other hand, it is slightly negatively correlated with all the other asset series. Nevertheless, the mean of the timevarying correlation coefficients for each pair is small, ranging only from mean -1.152154 to 0.000778, indicating that this crypto-currency can be used as a hedge in portfolios. T V.

# 11 Conclusion

Motivated by the Dyhrberg 2016 and Chen and Wang 2017 methodologies our objective was to examine variations in conditional correlations to determine when the Bitcoin acts as a hedge firstly against the American dollar and secondly against the stock markets using a univariate and a multivariate GARCH models. First of all, the GJR-GARCH model results for daily Bitcoin prices, exchange rates and stocks data during our sample period showed that: (1) BTC serves as a weak hedge for the stock market index changes in long term, with the exception of DAX30, during the period under study (2) BTC is a weak hedge against US dollar fluctuations in long term. Then, for the multivariate GARCH model results: (1) the mean of dynamic conditional correlation showed that the BTC can be considered as a diversifier more than a means of

emerging countries like Pakistan, Halaburda and Gandal 2014, Molnár and al 2015 and
Eisl and al 2015 indicate the inclusion of highly volatile Bitcoin into a diversified portfolio is highly profitable and they predicate if some investors lose trust to the entire economy, they might resort to Bitcoin. This is one of the reasons why Bitcoin has sometimes been called digital gold (Popper 2015). Arguing 2015 show that Bitcoin is a hedge against UK equities and American dollar. Baur and al 2015 conclude that crypto-currencies and

traditional asset classes are uncorrelated, making Bitcoin a useful diversification instrument in an investment portfolio. Brière and al 2015 found that the low correlation between Bitcoin and a diversified L portfolio of assets can be useful as an investment strategy. Dyhrberg 2016a shows that Bitcoin can acts as a hedge, sharing similar hedging capabilities to gold, against the American dollar and the UK stock market.
Dyhrberg 2016b compares asset capabilities and behavior of Bitcoin to those of gold and USD. She explains that Bitcoin is similar to gold in the way it reacts to news. Bouri and al 2017a prove that Bitcoin can be used as a hedge or a diversifier owing to the lowest connectedness between Bitcoin and other financial markets. Corbet and al 2017 find that Bitcoin, Ripple and Litecoin are not affected by external market shocks, thus, they are useful as a diversification and safe haven during the short run as they generate an increase in portfolio return. Added to this, there are a various ways used to discover the hedging capabilities of a financial asset against currency risk. To study the hedging capabilities of oil and gasoline spot prices against their futures prices, Chang and al 2010 use an OLS, a multivariate GARCH, an error correction and a state space models. Chang and al 2011 investigate the hedge ability of crude oil spot prices against their future prices by BEKK, CCC, DCC and VARMAGARCH models. Arouri and al 2011a, 2011b estimate a multivariate GARCH model to investigate first of all the volatility spillovers between oil, US and Europe stock markets over the period 1998 to 2009 and secondly between oil prices and stock markets in the Gulf Cooperation Council countries from 2005 to 2010. From January 1998 to December 2009, Arouri and al 2012 use a VAR-GARCH to model volatility dynamics between oil and European equity markets. Moreover, from January 2001 to December 2010, Sadorsky 2012 uses a multivariate GARCH model

Figure 1:

| Variables | Mean | S.D. | Min | Max | Skewness | Kurtosis | J-B | Obs |
|---|---|---|---|---|---|---|---|---|
| Panel A | | | | | | | | |
| Ret_BTC | 0.005475 | 0.070969 | -0.619039 | 0.467597 | -0.565764 | 17.29827 | 17563.42 | 2049 |
| Ret_SP500 | 0.000462 | 0.008960 | -0.068958 | 0.046317 | -0.546761 | 8.231341 | 2438.542 | 2049 |
| Ret_FTSE | 0.000197 | 0.009310 | -0.061994 | 0.039429 | -0.314212 | 6.256756 | 939.2423 | 2049 |
| Ret_DAX30 | 0.000365 | 0.012173 | -0.070673 | 0.052104 | -0.278632 | 5.783196 | 687.8427 | 2049 |
| Ret_CAC40 | 0.000222 | 0.012289 | -0.083844 | 0.068910 | -0.263486 | 6.405952 | 1014.102 | 2049 |
| Ret_HSI | 0.000169 | 0.011149 | -0.060183 | 0.055187 | - | | | |
| Panel B | | | | | | | | |
| Ret_BTC | 0.0059340 | 0.064762 | -0.470040 | 0.499663 | -0.029344 | 12.79516 | 8335.542 | 2085 |
| Ret_EUR | 0.0000073 | 0.005689 | -0.029953 | 0.026398 | 0.018167 | 4.697595 | 250.4735 | 2085 |
| Ret_GBP | 0.0000252 | 0.005455 | -0.029962 | 0.084006 | 1.782737 | 31.04006 | 69409.46 | 2085 |
| Ret_JPY | 0.0001170 | 0.005891 | -0.037722 | 0.034639 | | | | |
| Ret_CNY | -0.0000096 | 0.001719 | -0.010278 | 0.026954 | 1.841306 | 36.26811 | 97328.54 | 2085 |

Figure 2:

**3**

Note: * p<0.1, ** p<0.05, ***p< 0, standard errors in parentheses

Figure 3: Table 3 :

**4**

*[Note: Note: * p<0.1, ** p<0.05, ***p< 0, standard errors in parentheses]*

Figure 4: Table 4 :

**5**

| | | Mean equation | Variance equation |
|---|---|---|---|
| Ln( | ? 500 ) | 0.039024 (0.061333) | |
| Ln( | ? 500 ) | 0.077658 (0.061824) | |
| L.ar | | -0.032209 (0.020087) | |
| L.arch ? | | 109.3581 (7843.090) | |
| L.tarch ? | | -22.95347 (1646.668) | |
| L.garch ? | | 0.758723*** (0.017959) | |
| Constant | | 0.001749*** (0.000504) | 0.007576 (0.542918) |
| Ln( | ? ) | 0.062362 (0.054574) | |
| Ln( | ? ) | 0.037520 (0.054633) | |
| L.ar | | -0.031468 (0.020118) | |
| L.arch ? | | 105.1226 (7587.824) | |
| L.tarch ? | | -21.96385 (1570.824) | |
| L.garch ? | | 0.757413*** (0.018077) | |
| Constant | | 0.001765*** (0.000505) | 0.007702 (0.550265) |
| Ln( | ? 30 ) | 0.088492** (0.042350) | |
| Ln( | ? 30 ) | 0.047706 (0.042035) | |
| L.ar | | -0.032028 (0.020062) | |
| L.arch ? | | 110.6413 (7930.781) | |
| L.tarch ? | | -23.62137 (1693.653) | |
| L.garch ? | | 0.758519*** (0.017926) | |
| Constant | | 0.001781*** (0.000502) | 0.007556 (0.541204) |
| Ln( | ? 40 ) | 0.036586 (0.041018) | |
| Ln( | ? 40 ) | 0.044229 (0.040756) | |
| L.ar | | -0.032029 (0.020112) | |
| L.arch ? | | 108.4442 (7778.453) | |
| L.tarch ? | | -22.64406 (1624.669) | |
| L.garch ? | | 0.758416*** (0.017934) | |
| Constant | | 0.001774*** (0.000502) | 0.007393 (0.529896) |
| Ln( | ? ) | -0.015261 (0.044896) | |
| Ln( | ? ) | 0.072571 (0.045860) | |
| L.ar | | -0.031630 (0.020084) | |
| L.arch ? | | 107.4556 (7709.482) | |
| L.tarch ? | | -21.90181 (1571.842) | |
| L.garch ? | | 0.758041*** (0.018007) | |
| Constant | | 0.001776*** (0.000503) | 0.007775 (0.557419) |

Figure 5: Table 5 :

| | | DCC-GARCH | Asymmetric DCC-GARCH | | |
|---|---|---|---|---|---|
| PANEL A | | | | | |
| BTC/JPY | -0.014096 | 0.954584 | -0.015519 | 0.833332 | 0.007817 |
| | (0.023423) | (0.093241) | (0.009104) | (2.528956) | (0.054071) |
| BTC/GBP | -0.005187 | 0.982619 | -0.007451 | 0.793580 | 0.032418 |
| | (0.004492) | (0.041953) | (/) | (/) | (/) |
| BTC/EUR | -0.022613 | 0.913685 | -0.019531 | 0.948916 | 0.015861 |
| | (0.030966) | (0.140065) | (0.037174) | (0.102658) | (0.030263) |
| BTC/CNY | 0.022927 | 0.860495 | -0.002572 | 0.758424 | 0.075901 |
| PANEL B | (0.040692) | (0.184504) | (0.005166) | (0.270693) | (0.102756) |
| BTC/SP500 | | | 0.076272 | 0.709112 | -0.056543 |
| | 0.039013 | 0.749828 | (0.236363) | (0.876427) | (0.284955) |
| BTC/DAX30 | (0.150259) | (1.009953) | 0.001298 | 0.813735 | 0.013693 |
| | 0.009321 | 0.822222 | (0.295177) | (2.730911) | (0.405286) |
| BTC/FTSE | (/) | (/) | -0.042036 | 0.783839 | 0.060379 |
| | -0.038767 | 0.365096 | (0.016214) | (0.528017) | (0.178285) |
| | (0.149989) | (2.853451) | | | |
| BTC/CAC40 | 0,034543 | 0,790155 | -0.004175 | 0.891528 | -0.002758 |
| | (0,286954) | (59,56839) | (0.114745) | (1.369894) | (0.030671) |
| BTC/HSI | -0.01606 | 1.001130 | -0.025027 | 0.993308 | -0.014010 |
| | (0.292666) | (0.007693) | (/) | (/) | (/) |

Figure 6:

**7**

Figure 7: Table 7 :

**6**

| Variables | | | The mean of dynamic conditional correlation | |
|---|---|---|---|---|
| PANEL A | | | | |
| BTC/JPY | | | -0.00044505 | |
| BTC/GBP | | | -0.00567043 | |
| BTC/EUR | | | -0.00324883 | |
| BTC/CNY | | | -0.00158053 | |
| PANEL B | | | | |
| BTC/SP500 | | | 0.00012597 | |
| BTC/FTSE100 | | | 0.00438880 | |
| BTC/DAX30 | | | 0.00365595 | |
| BTC/CAC40 | | | -0.00158689 | |
| BTC/HSI | | | -0.01074421 | |
| VARIABLES | MIN | MAX | MEAN | ST.DEV |

*[Note: currency is regarded as a hedge in portfolios (2) the fluctuations and for all the other asset our crypto-]*

Figure 8: Table 6 :

(the univariate GARCH result). A noteworthy finding of our study is that Bitcoin is the digital gold and can be regarded like gold to eliminate or minimize specific market risks as a hedge highlighting its monetary asset role. Otherwise, it can be added in the variety of possible tools to market analysts to hedge market risks. Even more, Bitcoin creates a new opportunity for investors in terms of risk management, portfolio analysis and the stockholders sentiment in the financial market **??**Dyhrberg 2016). In light of these results, more researches should be done in order to uncover the financial aspect of this phenomenon.

summary statistics of conditional correlations between the Ret_BTC and Ret_of each other series pair showed that this crypto-currency is a hedge against all financial assets changes except DAX30, confirming our first result 9.

# .1 16


[Baur and Mcdermott ()] , D G Baur , T K Mcdermott . *Journal Banking Finance* 2010. 34 p. . (is gold a safe haven? International evidence)

[Bollerslev et al. ()] 'A Capital Asset Pricing Model with Time-Varying Covariances'. T Bollerslev , R Engle , F Wooldridge , J , M . *Journal of political economy* 1988. 96 (1) .

[Mensi et al. ()] 'Are Sharia stocks, gold and U.S. Treasury hedges and/or safe havens for the oilbased GCC markets?'. W Mensi , S Hammoudeh , J Reboredo , C Nguyen , D . *Emerging Markets Review* 2015. 24 p. .

[Cappiello and Engle ()] 'Asymmetric Dynamics in the Correlations of Global equity and Bond Returns'. L Cappiello , . R F Engle , Sheppard . *Journal of Financial Econometrics* 2006. 4 p. .

[Bhatia and Das ()] V Bhatia , Mitra S K Das . *Crude Oil Hedging With Precious Metals: A DCC-Garch*, 2018. 22.

[Bouri and Molnár ()] 'Bitcoin for energy commodities before and after the December 2013 crash: diversifier, hedge or safe haven?'. Jalkh E N Bouri , Roubaud P Molnár . *Applied Economics* 2017b.

[Halaburda and Gandal ()] *Competition in the Cryptocurrency Market*, H Halaburda , Gandal . 2014. (Working paper)

[Chang et al. ()] 'Crude oil hedging strategies using dynamic multivariate GARCH'. C Chang , M Mcaleer , Tansuchat . *Energy Economics* 2011. 33 p. .

[Eisl et al. ()] *Does Bitcoin Improve Portfolio Diversification?*, S A M Eisl , K Gasser , Weinmayer . 2015. (Working paper)

[Chen] 'Does Gold Act as a Hedge and a Safe Haven for China's Stock Market?'. K Chen , Wang . *International Journal of Financial Studies*

[Bredin et al. ()] 'does gold glitter in the long-run? Gold as a hedge and safe haven across time and investment horizon'. D Bredin , T Conlon , Potì . *International Review of Financial Analysis* 2015. 41 p. .

[Iqbal and Jav ()] 'does gold hedge stock market, inflation and exchange rate risks? An econometric investigation'. Iqbal , Jav . *International Review of Economics and Finance* 2017. 48 p. .

[Dyhrberg et al.] . A Dyhrberg , Bitcoin , Dollar . *GARCH volatility analysis*, p. .

[Engle ()] 'Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models'. R Engle . *Journal of business and economic statistics* 2002. 20 (3) p. .

[Jain and Biswal ()] 'Dynamic linkages among oil price, gold price, exchange rate and stock market in India'. A Jain , P Biswal . *Resources Policy* 2016. 49 p. .

[Parhizgari and Cho ()] 'East Asian financial contagion under DCCGARCH'. A Parhizgari , M Cho , J , H . *International Journal of Banking and Finance* 2008. 6 (1) p. .

[Corbet ()] 'exploring the Dynamic Relationships between Crypto currencies and Other Financial Assets, Preprint submitted to Elsevier'. Corbet . *Procedia-Social and Behavioral Sciences* 2017. 2016. 229 p. . (Debrova. A)

[Capie and Mills ()] 'Gold as a hedge against the dollar'. F Capie , . T C Mills , Wood . *Journal of International Financial Markets. Inst. Money* 2005. 15 p. .

[Nguyen et al. ()] 'Gold price and stock markets nexus under mixed-copulas'. Cuong M Nguyen , I Bhatti , M Komorníková , Komorník . *Economic Modelling* 2016. 58 p. .

[Ciner et al. ()] 'Hedges and safe havens: an examination of stocks bonds, gold, oil and exchange rates'. C Ciner , C Gurdgiev , B Lucey . *International review Financial analysis* 2013. 29 p. .

[Dyhrberg ()] 'Hedging capabilities of Bitcoin. Is it the virtual gold?'. . A Dyhrberg . *Finance Research Letters* 2016a. p. .

[Pan ()] 'Hedging crude oil using refined product: A regime switching asymmetric DCC approach'. Wang Z Y Pan , Yang . *Energy Economics* 2014. 46 p. .

[Baur and Lucey ()] 'Is gold a hedge or a safe haven an analysis of stocks, bonds and gold'. D G Baur , B M Lucey . *The Financial Review* 2010. 45 p. .

[Gürgün ()] 'Is gold a safe haven against equity market investment in emerging and developing countries?'. Gözde Gürgün , Ünalm?s . *Finance Research Letters* 2014. 11 p. .

[Hood ()] 'Is gold the best hedge and a safe haven under changing stock market volatility?'. Malik M F Hood . *Review of Financial Economics* 2013. 22 p. .

[Hood and Malik ()] 'Is gold the best hedge and a safe haven under changing stock market volatility?'. M Hood , F Malik . *Review of financiaal economics* 2013. 22 (2) p. .

[Engle and Ndong ()] 'Measuring and testing the impact of news on volatility'. . R F Engle , . V Ndong . *Journal of Finance* 1993. 48 p. .

[Hafner and Reznicova ()] 'On the estimation of dynamic conditional correlation models'. C Hafner , M Reznicova , O . *Computational Statistics and Data Analysis* 2012. 56 (11) p. .

[Bouri et al. ()] 'On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?'. E Bouri , Azzi P G Molnár , Roubaud D Hagfors , .I . *Finance Research Letters* 2017a. 20 p. .

[Glosten ()] 'on the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks'. L R Glosten , JagannathanR , RunkleD . *The Journal of Finance* 1993. 48 p. .

[References Références Referencias] *References Références Referencias*,

[Taufiq et al. ()] 'Relationship between Gold and Stock Markets during the Global Financial Crisis: Evidence from Nonlinear Causality Tests'. Choudhry Taufiq , S Syed , Sarosh Hassan , Shabi . *International Review of Financial Analysis* 2015. 41 p. .

[An-Sing and Lin ()] 'the relation between gold and stocks: An analysis of severe bear markets'. Chen An-Sing , James Lin . *Applied Economics Letters* 2014. 21 p. .

[Brière et al. ()] 'Virtual currency, tangible return: Portfolio diversification with bitcoin'. M Brière , K Oosterlinck , Szafarz . *Journal of Asset Management* 2015. 16 p. .