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Hedging capabilities of bitcoin. Is it the virtual gold?

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ABSTRACT

This paper sets out to explore the hedging capabilities of bitcoin by applying the asymmetric GARCH methodology used in investigation of gold. The results show that bitcoin can clearly be used as a hedge against stocks in the Financial Times Stock Exchange Index. Additionally bitcoin can be used as a hedge against the American dollar in the short-term. Bitcoin thereby possess some of the same hedging abilities as gold and can be included in the variety of tools available to market analysts to hedge market specific risk.

1. Introduction

The cryptocurrency bitcoin has posed great challenges and opportunities for policy makers, economists, entrepreneurs and consumers since its introduction by Nakamoto (2008). Bitcoin is different from any other asset on the financial market and thereby creates new possibilities for stakeholders with regard to risk management, portfolio analysis and consumer sentiment analysis. Though as bitcoin is still considered to be mysterious and not very well understood by many stakeholders in the financial market analysis of the capabilities of bitcoin with regard to different financial aspects must be performed.

Generally analysis of the financial capabilities of an asset often considers the liquidity, reactivity to the variance of other assets as well as the hedging abilities of the asset in question. Thereby the analysis will give a detailed view of the interaction of the financial asset in the market and what place is has comparably

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Table 1
Summary statistics.

VARIABLES	N	Mean	sd	Min	max
Time	1,769	885	510.8	1	1,769
Bitcoin Price Index	1,769	170.3	240.1	0.0505	1,147
Ln(price)	1,769	3.145	2.687	−2.986	7.045
USD-EUR Exchange rate	1,769	1.316	0.0796	1.052	1.489
Ln(USD-EUR Exchange rate)	1,769	0.273	0.0629	0.0508	0.398
USD-GBP Exchange rate	1,769	1.591	0.0506	1.464	1.717
Ln(USD-GBP Exchange rate)	1,769	0.464	0.0318	0.381	0.541
FTSE index	1,769	6,150	523.4	4,944	7,104
Ln(FTSE index)	1769	8.721	0.086	8.506	8.868

to other assets. Previous research has investigated the liquidity and means of exchange of bitcoin (Glaser et al. 2014), the diversification possibilities (Briere et al., 2013) and the arbitrage possibilities (Gandal and Halaburda, 2014). However this paper intends to explore the hedging capabilities of bitcoin thereby giving a more detailed view of the asset and its capabilities in portfolio analysis and risk management.

Bitcoin has previously been compared to gold as they have many similarities; the primary value is derived due to scarcity of supply, supply is not controlled by a government but independent agents, both assets have high price volatility and total supply is finite. As gold has well-known hedging capabilities against stocks, bonds and the American dollar bitcoin might exhibit similar correlations. This paper will thereby be modelled after previous research of gold using the same methodology. Thus the results can be compared and contrasted to get a sense of the comparable hedging capabilities of bitcoin.

The paper will be structured as follow. Section 2 will introduce the data, the specification and methodology. Section 3 presents the results and Section 4 concludes.

2. Data and econometric modelling

The data used for this paper is scoured from Datastream and include daily observations from the 19th of July 2010 to 22nd of May 2015 of the dollar-euro and dollar-sterling exchange rates as well as the Financial Times Stock Exchange Index (FTSE) yielding 1769 observations. The bitcoin price data is sourced from the Coindesk Bitcoin Price Index (Coindesk, 2015) with daily observations.

Summery statistics are shown in Table 1 and indicate a large range of fluctuations in each of the series which is common among financial assets and can also be identified in Fig. 1. Consequently logarithms are used throughout the analysis. The KPSS and DF-GLS tests indicated a unit root for the bitcoin price, the exchange rates and the FTSE Index implying nonstationarity which is common in time series as means and variances vary over time.[1] Further investigation showed that first differences of the variables eliminated the nonstationarity so each series was transformed according to the equation $\Delta x_t = x_t - x_{t-1}$.

2.1. Models

Different models will be used to get a detailed view of the hedging capabilities of bitcoin against different assets and portfolios. The papers by Baur and Lucey (2010) and Capie et al. (2005) investigated the hedging capabilities of gold against stocks, bonds and the American dollar. As gold and bitcoin have many similar traits the same methodology and similar explanatory variables will be applied in this paper. Both Baur and Lucey (2010) and Capie et al. (2005) assumed that the errors exhibited conditional autoregressive heteroscedasticity and thereby used asymmetric GARCH models to identify volatility correlations. Engle's Lagrange multiplier test showed high ARCH effects in the residuals of the bitcoin return which makes GARCH modelling suitable for this paper.[2] In Addition an AR(1) process was identified for

[1] Details of tests and test statistics are available upon request.
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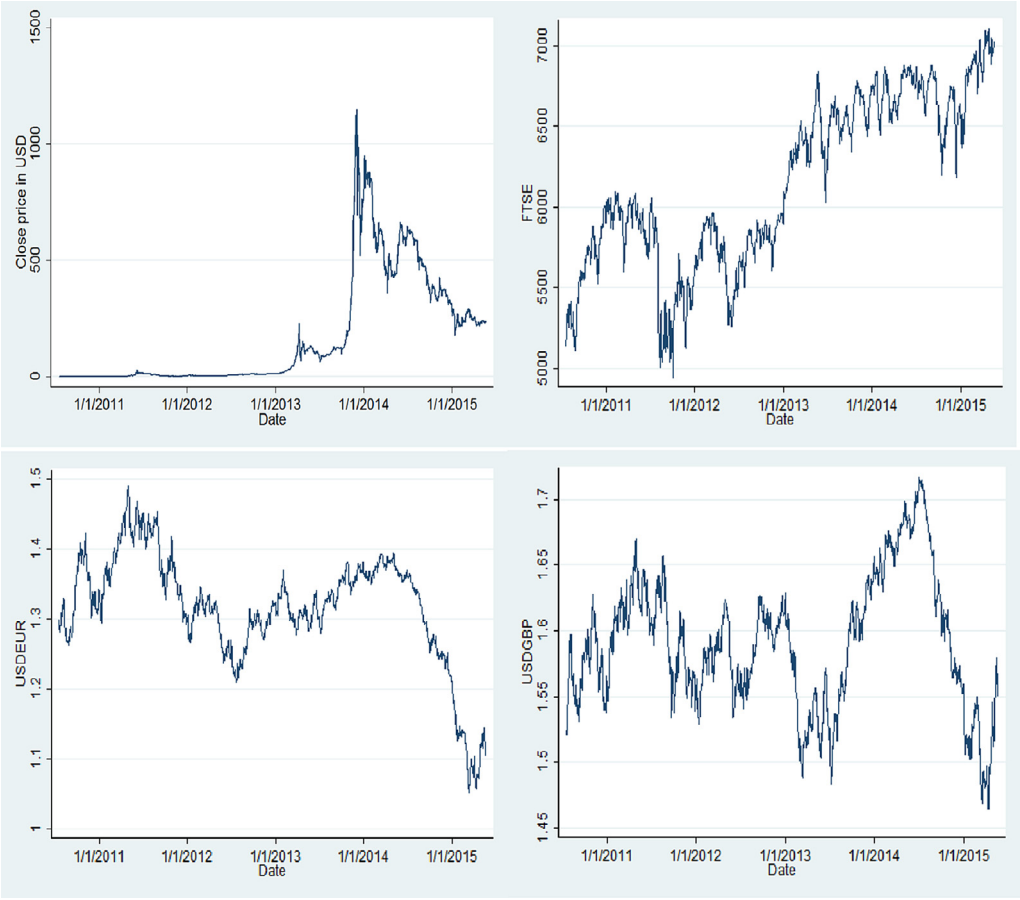

Fig. 1. Levels of the Bitcoin Price Index, the FTSE index, the dollar-euro exchange rate and the dollar-sterling exchange rate from July 19th 2010 to May 22nd 2015.

the return on bitcoin which will be reflected in the mean equation similarly to the model by Capie et al. (2005).

It is important to estimate asymmetric models to be able to describe the dynamic relationship between the variables in question. There is a tendency among time series for volatility to decline when return increase and rise when returns decrease, known as the leverage effect which makes asymmetry crucial in modelling. The models in this paper also distinguish between the contemporaneous and lagged shock effects which is important in analysis. Asymmetric models will additionally be used to ensure comparability with the results from previous research. The variables included will however be different so direct comparability between coefficients are not possible. Therefore the models will be threshold GARCH models introduced by Glosten et al. (1993) with Gaussian normal distributed error.

2.1.1. Hedge against the FTSE Index model

Baur and Lucey (2010) analysed the hedging capabilities of gold against the MSCI stock and bond total return indices using an asymmetric ARCH model. Similarly the model in this paper will analyse the relationship between the return on bitcoin and the FTSE Index in an asymmetric ARCH model which thereby will identify if bitcoin can be used as a hedge against the 100 largest companies by market capitalisation listed on the London stock exchange. However to isolate this correlation one will have to assume that

bitcoin does not affect the Financial Times Stock Exchange Index to eliminate any reverse causality and possible endogeneity. This will not be a strong assumption as the likelihood that the price of bitcoin affects the market capitalisation of the 100 largest companies listed on the London stock exchange is slim. The model to analyse the relationship will include contemporaneous and lagged values of the Financial Times Stock Exchange Index in the mean equation. The variables will not be included in the variance equation to follow the method of Baur and Lucey (2010). The mean Eq. (1) and the variance Eq. (2) are shown below.

$$\Delta lnprice_t = \beta_0 + \beta_1 lnprice_{t-1} + \beta_2 \Delta lnFTSE_t + \beta_3 \Delta lnFTSE_{t-1} + \varepsilon_t \quad (1)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \lambda d_{t-1} \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2)$$

2.1.2. Hedge against the dollar model

Capie et al. (2005) investigated the hedging capabilities of gold as a hedge against the dollar using an asymmetric GARCH. The paper originated their analysis with a crosscorrelogarm to establish the correlation between gold and the sterling-dollar, yen-dollar exchange rates. Building on that they estimated an asymmetric GARCH. The model in this paper will be a threshold GARCH to capture the dynamic relationship. The specification will thereby be similar to the one used by Capie et al. (2005) and leads to the following mean Eq. (3) and variance Eq. (4) for the dollar-euro exchange rate and (5) and (6) for the dollar-sterling exchange rates.

$$\Delta lnprice_t = \beta_0 + \beta_1 lnprice_{t-1} + \beta_3 \Delta lnUSDEUR_t + \beta_4 \Delta lnUSDEUR_{t-1} + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \lambda d_{t-1} \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (4)$$

$$\Delta lnprice_t = \beta_0 + \beta_1 lnprice_{t-1} + \beta_3 \Delta lnUSDGBP_t + \beta_4 \Delta lnUSDGBP_{t-1} + \varepsilon_t \quad (5)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \lambda d_{t-1} \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (6)$$

Therefore the coefficient β_0 show if the return on bitcoin has an upward or downward drifting process which may be possible as seen in Fig. 1. The coefficient β_3 is the one particularly of interest as its sign and significance show whether bitcoin has hedging capabilities. These two approaches from previous research will investigate if bitcoin has any possibilities in risk management and portfolio analysis and will give further detail to the capabilities of bitcoin in the financial marketplace.

3. Results

The output of the threshold GARCH model inspired by Baur and Lucey (2010) is shown in Table 2. The sign and significance of the contemporaneous effect suggests that bitcoin is uncorrelated with the assets in the FTSE Index on average. Thereby the return on bitcoin is not affected by changes in the stock market which creates a possibility for investors to hedge some of the market risk. The result is similar to the ones found for gold by Baur and Lucey (2010) indicating that bitcoin and gold have similar hedging capabilities in the UK market. Investors in the United Kingdom can thereby use gold as well as bitcoin to counteract specific market risk as bitcoin is uncorrelated with the 100 largest companies by market capitalisation listed on the London stock exchange and the return on gold is negatively correlated with the return on stocks and bonds in the UK market.

Capie et al. (2005) found that gold can be used as a hedge against the dollar as it is not controlled by the same institutions as the ones controlling currencies. Bitcoin has the same characteristics as no government is controlling the production, so one could speculate that the same relationship would exists for bitcoin. To investigate the hedging capabilities of bitcoin, two exchange rates have been included in a crosscorrelogram, specifically the dollar-euro and dollar-sterling exchange rates. Table 3 shows the output and indicates that there are very small correlations and that the exchange rates positively lead the return on bitcoin. The contemporaneous effects are positive though very small suggesting that bitcoin cannot be used as a hedge against the exchange rates. However as the correlations are very small the dynamic relationship is likely to be short-term and one may therefore question their significance.

Capie et al. (2005) found similar small though negative values of correlation between the return on gold and return on the sterling-dollar and yen-dollar exchange rates indicating the well know hedging capability of gold as the “anti-dollar”. However the authors did note that due to the small values any

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Table 2
T-GARCH(1,1) with Financial Times Stock Exchange Index and dependent variable return on bitcoin investment.

VARIABLES	Mean equation	Variance equation
Ln(FTSE index)$_t$	–0.00935	
	(0.0992)	
Ln(FTSE index)$_{t-1}$	–0.0534	
	(0.121)	
L.ar	0.0848***	
	(0.0283)	
L.arch α		0.299***
		(0.0184)
L.tarch λ		0.112***
		(0.0303)
L.garch β		0.682***
		(0.00884)
Constant	0.00180*	0.000190***
	(0.00105)	(9.01e-06)
Observations	1,767	1,767

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$.
* $p < 0.1$.

Table 3
Crosscorrelogram $r\Delta x$, $\Delta lnprice(k)$.

	$k=-4$	$k=-3$	$k=-2$	$k=-1$	$k=0$	$k=1$	$k=2$	$k=3$	$k=4$
Dollar Euro	0.0270	-0.0058	0.0208	0.0373	0.0209	0.0526	–0.0059	–0.0343	–0.0309
Dollar Sterling	0.0162	–0.112	0.0151	0.0586	0.0118	0.0303	–0.0092	–0.0299	–0.164

Note: $r\Delta x$, $\Delta lnprice(k)$ is the correlation between the return on the exchange rates and the bitcoin return denoted by $\Delta lnprice_t$.

Table 4
T-GARCH(1,1) Exchange rate returns with dependent variable return on bitcoin.

	Dollar Euro Exchange rate		Dollar Pound Exchange rate	
VARIABLES	Mean equation	Variance equation	Mean equation	Variance equation
Ln(USD-EUR Exchange rate)$_t$	0.0263			
	(0.161)			
Ln(USD-EUR Exchange rate)$_{t-1}$	0.338**			
	(0.163)			
L.ar	0.0837***		0.0849***	
	(0.0291)		(0.0297)	
L.arch α		0.305***		0.301***
		(0.0196)		(0.0193)
L.tarch λ		0.116***		0.113***
		(0.0301)		(0.0302)
L.garch β		0.677***		0.680***
		(0.00938)		(0.00916)
Ln(USD-GBP Exchange rate)$_t$			–0.175	
			(0.190)	
Ln(USD-GBP Exchange rate)$_{t-1}$			0.377*	
			(0.206)	
Constant	0.00183	0.000190***	0.00183	0.000190***
Observations	1,767	1,767	1,767	1,767

Standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

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relationship if it exists must be very short lived. The differences in the results may be due to the data used. Capie et al. (2005) used weekly observations from 1971 to 2004 which is a much longer period at a lower frequency than the one used in this paper. As the time period is much larger the data captures several bullish and bearish periods which provides a much richer correlation analysis. In Addition, Capie et al. (2005) do not distinguish between extreme and average financial shocks, which will affect the extent to which gold is used and is useful as a hedge. If they had done so, a comparison may have been possible between similar financial shocks to the recession occurring in 2010–2012. This analysis also uses slightly different exchange rates which will also affect the conclusion. Furthermore bitcoin and gold are different in some regards and gold is much more established in the market as a tool for hedging so the results are likely to be different.

By estimating a threshold GARCH one can study these correlations in more detail. Table 4 shows the output of the estimated model and suggests that bitcoin can be used as a hedge against the dollar as the contemporaneous effect on both exchange rates are insignificant and thereby uncorrelated on average. Through the lagged dollar-euro exchange rate is positive and significant with the dollar-sterling exchange rate being positive and significant at the 90% significance level. Therefore any hedging capability is very short-term. It is however likely that a short term hedging capability is enough as bitcoin is traded at very high frequencies. The results are similar to those of Capie et al. (2005) though they did get insignificant lagged values. The differences in results show that the hedging abilities of bitcoin against the dollar are shorter lived than the hedging abilities of the gold against the dollar.

4. Conclusion

This paper sat out to investigate the hedging capabilities of bitcoin against stocks in the Financial Times Stock Exchange Index and the American dollar. Overall bitcoin has clear hedging capabilities against the FTSE Index and can thereby be used alongside gold to eliminate or minimize specific market risks. Against the dollar, the conclusion slightly more vague as correlations were found though very small values. Though bitcoin did show hedging capabilities against the dollar in the short-term indicating that the high frequency trading of bitcoin creates suitable conditions for such hedging to be conducted. In conclusion bitcoin has a clear place in the market for portfolio analysis and risk management as it can be used as a hedge against the FTSE Index and the American dollar. Thereby bitcoin can be added to the list of instruments alongside gold and other assets to minimize risks. Additionally as bitcoin is traded at high and continuous frequencies with no days where trading is closed, like other assets, bitcoin has specific speed advantages and add to the already rich list of hedging tools available to analysts.

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