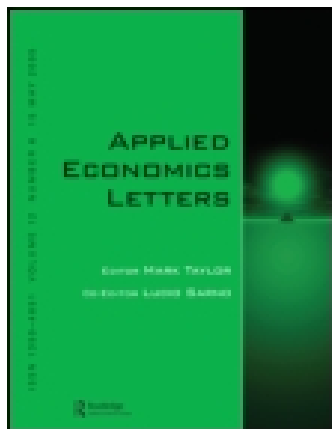


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Publisher: Routledge

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## Applied Economics Letters

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/rael20>

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Published online: 26 Aug 2014.

To cite this article: C. Baek & M. Elbeck (2015) Bitcoins as an investment or speculative vehicle? A first look, Applied Economics Letters, 22:1, 30-34, DOI: [10.1080/13504851.2014.916379](https://doi.org/10.1080/13504851.2014.916379)

To link to this article: <http://dx.doi.org/10.1080/13504851.2014.916379>

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# Bitcoins as an investment or speculative vehicle? A first look

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We use Bitcoin and S&P 500 Index daily return data to examine relative volatility using detrended ratios. We then model Bitcoin market returns with selected economic variables to study the drivers of Bitcoin market returns. We report strong evidence to suggest that Bitcoin volatility is internally (buyer and seller) driven leading to the conclusion that the Bitcoin market is highly speculative at present.

**Keywords:** Bitcoin; speculation; investment; detrended ratio; exponential trend

**JEL Classification:** G11; G14

## I. Introduction

US congressional discussion to regulate Bitcoins (Nicks, 2013) and the recent Chinese government's decision to shut down Bitcoin exchanges (Hill, 2014) have not diminished interest in Bitcoins, likened to a valuable asset approaching the price of gold (Watts, 2013). Reports of investment houses toying with a Bitcoin fund (Primack, 2014) and the introduction of automated teller machines in the US for consumers to buy and sell Bitcoins (Wahba, 2014) motivates the purpose of this article to investigate whether Bitcoins are an investment or speculative vehicle.

From a macroeconomic perspective, Bitcoins are presented as extremes. On the one hand, they are a panacea to replace financial institutions (Kerner, 2014), an alternative to cash (Evans-Pughe, 2012) and a hedge against economies with rampant inflation (Richardson, 2014). On the other hand, they are a money laundering conduit (Stokes, 2012) and a

force for global economic destabilization (Plassaras, 2013; Matthews, 2014).

The numerous conceptual pieces are balanced with a limited number of empirical papers focusing on Bitcoin operations such as the likelihood of Bitcoin exchange default (Moore and Christin, 2013), Bitcoin mining manipulation (Eyal and Sirer, 2013) and Bitcoin user anonymity (Ober *et al.*, 2013). The absence of empirical works addressing Bitcoins as an investment vehicle is the motive for this study.

Consistent with the traditional approach to assess an investment opportunity, we limit our study to volatility (risk) and return with the following two questions. (1) What is the Bitcoin's market volatility? And (2) what drives Bitcoin market returns? We compare the Bitcoin market with the stock market to report Bitcoin market risk relative to the stock market. Then, we examine if fundamental economic variables affect the Bitcoin market returns. Given the growing popularity of Bitcoins, our study offers

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empirical evidence for potential investors in a timely manner.

## II. Data

Bitcoin data are downloaded from [www.bitcoincharts.com](http://www.bitcoincharts.com) as daily prices (\$US) from July 2010 to February 2014. We also collect fundamental economic data from the Federal Reserve Bank of St. Louis. These variables include the consumer price index, industrial production, real personal consumption expenditures, S&P 500 index, 10-year Treasury note, euro exchange rate and the national average unemployment rate. Monthly data are available for all these variables except for daily data from the daily S&P 500 index and 10-year Treasury note.

## III. Empirical Results

### Bitcoin market versus stock market

We first examine Bitcoin market inherent risk by comparing its volatility with that of the stock market. Figures 1 and 2 show the Bitcoin prices and the S&P 500 index values, respectively, from July 2010 to February 2014.

Since we clearly observe an increasing trend in both time series during this time period, we detrend both series to allow for direct comparison. The following minimization is used to find the exponential trend.

$$\text{Min}_{(a, r, b)} \sum_{t=1}^n (x_t - y_t)^2 \quad (1)$$

where  $x_t$  is an actual value and  $y_t = ae^{rt} + b$  at time  $t$ . Table 1 reports estimated coefficient values for the exponential trend,  $y_t$ .

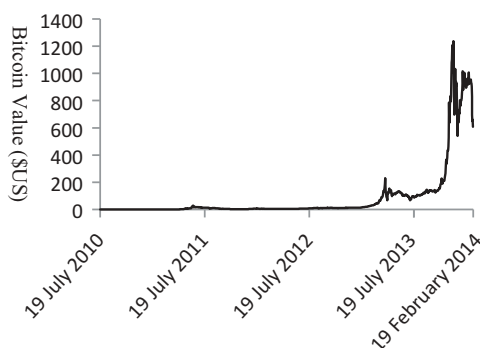


Fig. 1. Bitcoin value

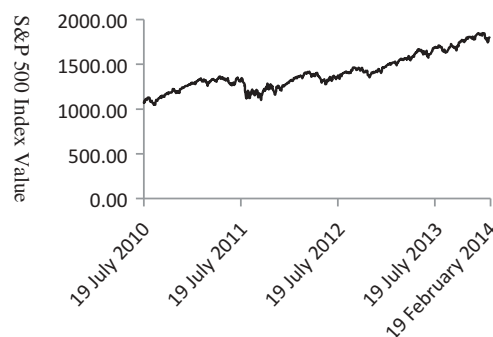


Fig. 2. S&P 500 index value

Table 1. Estimated coefficients for the exponential trend

Estimated coefficient	Bitcoin	S&P 500 index
$a$	0.0015	79.0338
$r$	0.0104	0.0025
$b$	3.0404	1104.6590

Note: We use Excel Solver to find the optimized exponential trend curve.

The optimized exponential trends for the Bitcoin and the S&P 500 index are shown in Figs 3 and 4, respectively.

Of the two common ways to detrend a time series (subtraction and ratio), we calculate detrended ratios to correctly compare volatilities of two different markets regardless of their dimensions.

$$\text{Detrended Ratio}_t = \frac{AV_t}{TV_t} \quad (2)$$

where  $AV_t$  is the actual value at time  $t$  and  $TV_t$  is the trend value at time  $t$ . Figures 5 and 6 show detrended ratios for both series.

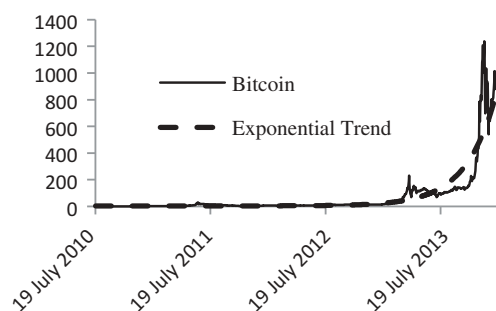


Fig. 3. Exponential trend for Bitcoins

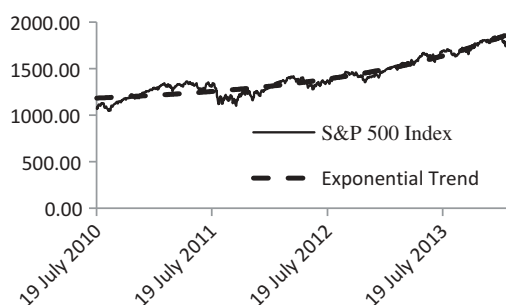


Fig. 4. Exponential trend for S&P 500

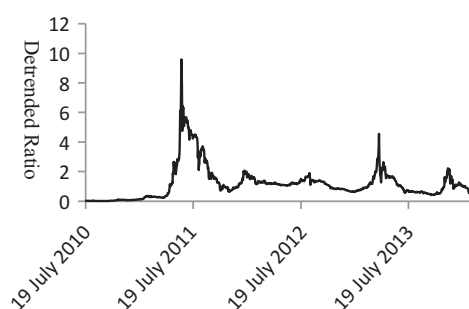


Fig. 5. Detrended ratio of Bitcoins

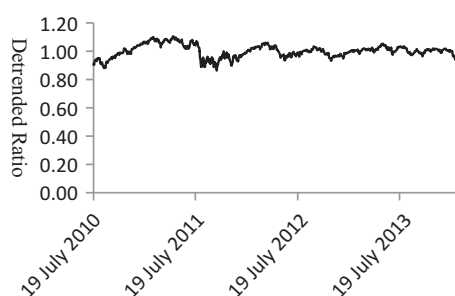


Fig. 6. Detrended ratio of S&P 500

Table 2. Statistical measures of detrended ratios

Statistical measure	Bitcoin	S&P 500 index
SD	1.1552	0.0447
Skewness	2.5474	-0.1846
Excess kurtosis	9.2062	-0.0308

As a simple volatility measure, the SD of detrended ratios for each market is reported in Table 2. While the SD of detrended ratios for the Bitcoin is 1.1552, the detrended ratios for the stock market is 0.0447. Thus, the Bitcoin

market is about 26 times as volatile as the stock market during this time period. The Bitcoin market is quite positively skewed whereas the stock market is slightly negatively skewed. In addition, the Bitcoin market has a positive excess kurtosis that causes a fat tail suggesting more chances for extreme values to occur. In summary, the Bitcoin market appears to be highly risky and speculative relative to the stock market.

#### What drives Bitcoin market returns?

Next, we are interested in identifying drivers of Bitcoin market returns. We conduct a regression analysis using fundamental economic variables. Since only monthly data are available for most of these variables, we calculate monthly changes for all those variables. The following regression is conducted with the Newey–West's heteroscedasticity and autocorrelation consistent (HAC) covariance estimator:

$$\begin{aligned}
 R_t = & \beta_0 + \beta_1 \Delta cpi_t + \beta_2 \Delta ip_t + \beta_3 \Delta rpce_t \\
 & + \beta_4 \Delta sp500_t + \beta_5 \Delta TN_t + \beta_6 \Delta euro_t \\
 & + \beta_7 \Delta unemployment_t + \beta_8 \Delta spread_t + \varepsilon_t
 \end{aligned}
 \quad (3)$$

where  $R_t$  is the monthly change in the Bitcoin price,  $\Delta cpi_t$  is the monthly change in consumer price index,  $\Delta ip_t$  is the monthly change in industrial production,  $\Delta rpce_t$  is the monthly change in real personal consumption expenditures,  $\Delta sp500_t$  is the monthly change in S&P 500 index,  $\Delta TN_t$  is the monthly change in the 10-year Treasury note,  $\Delta euro_t$  is the monthly change in Euro exchange rate,  $\Delta unemployment_t$  is the monthly change in national average unemployment rate and  $\Delta spread_t$  is the monthly change in the spread between daily high and low Bitcoin prices. We use all these fundamental variables as external Bitcoin market factors except for  $\Delta spread_t$ . The spread between daily high and low prices is added as an internal Bitcoin market factor.

Table 3 reports the regression results. The variance inflation factor (VIF) for each variable is calculated, suggesting multicollinearity between these variables because all VIFs are greater than 1. Nonetheless, there is no serious multicollinearity during this time period given the VIFs are less than 4 (Cohen *et al.*, 2003, p. 423).

**Table 3. Regression results**

Variable	Estimated coefficient	t-Ratio	VIF
Constant	0.1955	0.2578	
Monthly change in consumption price index	25.4100	0.9949	1.3829
Monthly change in industrial production	-7.5773	-0.4870	1.6147
Monthly change in real personal consumption expenditures	7.6659	0.2524	1.4465
Monthly change in S&P500 index	2.1364	1.0430	1.7479
Monthly change in 10-year Treasury note	-0.0122	-0.0270	1.3552
Monthly change in euro exchange rate	-1.0050	-0.4672	2.1142
Monthly change in unemployment	-0.9216	-0.0873	1.2860
Monthly change in the spread between daily high and low prices	0.1837**	6.028	1.0153
Adjusted $R^2$	0.3432		

Notes: The variance inflation factor (VIF) is calculated as follows:  $VIF_i = \frac{1}{1-R_i^2}$  where  $VIF_i$  is the variance inflation factor of an independent variable,  $X_i$ , and  $R_i^2$  is the multiple  $R^2$  of  $X_i$  on the other independent variables.

\* indicates statistical significance at the 0.05 level.

\*\* indicates statistical significance at the 0.01 levels.

The interesting finding is that only the spread between daily high and low prices as an internal factor of the Bitcoin market is statistically significant. All external economic factors do not appear to have any significant impact on the Bitcoin market returns. This implies that the Bitcoin market returns are mostly internally driven by market participants. The significant influence of this single internal factor is compatible with the notion that Bitcoins are at the introductory life-cycle stage, with significant external variable influences likely to occur once competition and/or popular acceptance of Bitcoins occurs.

#### IV. Concluding Remarks

To answer our first question about Bitcoin market volatility, the SD of detrended ratios from Table 2 shows that Bitcoins are 26 times more volatile than the S&P 500 Index. For our second question about the drivers of Bitcoin market returns, the regression results in Table 3 suggest that the Bitcoin returns are internally driven by buyers and sellers and are not influenced by fundamental economic factors.

The question ‘should Bitcoins be considered an investment or speculative vehicle’ is best answered according to the investor’s appetite for risk. The results suggest Bitcoins as a speculative vehicle driven by Bitcoin exchange participants (buyers and sellers). Nonetheless, if Bitcoin usage grows, then we expect Bitcoin volatility to drop and attract market and economic influence representing a more

balanced internally and externally driven investment vehicle.

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