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Determinants to be considered while investing in cryptocurrency markets: A case of bitcoin

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Abstract
When Bitcoin became one of the world's most popular investment options, the cryptocurrency industry has showed potential development, and it had a similar influence on the Indian financial sector too. Aside from Bitcoin, other altcoins are gaining popularity and dominating the cryptocurrency market. As a result, the goal of this research is to identify at the macroeconomic factors that influence Bitcoin prices, such as the USD/INR exchange rate, gold prices, crude oil prices, the New York Stock Exchange Dow Jones (NYSE) price, NIFTY price, and Sensex price, as well as the prices of nine alternative cryptocurrencies in the cryptocurrency market: Binance coin, Bitcoin Cash, Bitcoin SV, Ether, Ethereum, Litecoin, Monero, Tether, and ripple. Bitcoin volume and market capitalization are additional factors, undertaken in the study, that are potential influencers of cryptocurrency pricing. The time series data, which comprises of bi-weekly data for all variables, will be used from 2015 to 2020. The OLS (ordinary least square) regression model in EVIEWS will be used in this study to conduct an empirical analysis.

Keywords: Bitcoin, macroeconomic factors, cryptocurrency, investment, altcoins

Introduction
Due to its quick development and rising market value, cryptocurrency has captured the interest of the general public, investors, and policymakers in recent years. Although it was created in 2009, the digital currency Bitcoin did not get the attention of the mainstream media until 2012 (Corbet, *et al*., 2018; Erdas & Caglar, 2018; Kurka, 2019; Baumöhl, 2019) [7, 11, 18, 4]. Bitcoin and other digital currencies are frequently likened to cash due to their purported anonymity. However, unlike cash, these currencies are entirely digital and are mostly utilised online (Gandal & Halaburda, 2016) [12]. While there are many different types of digital currencies, the decentralised digital currencies based mostly on cryptography, known as cryptocurrencies, have received the most interest. Bitcoin is the most well-known cryptocurrency.

Blockchain is the core technology behind bitcoin. It is a disseminated, decentralized database and is designed to accomplish consistent and reliable agreement over a record of events between independent participants. Participants during a blockchain network get to agreement about changes to the state of the shared database without having to trust the integrity of any network participants or administrators. Anyone who participates within the blockchain network has their own data store that stores all of the transactions that ever happened on the network (also referred to as the distributed ledger) (Anderson *et al*., 2017) [1].

India seems to have suppressed the growth of the outbreaks. Since the government has not authorized Bitcoins, it has decided to introduce its own cryptocurrency named “Lakshmi” (Trivedi, M, 2018). In the Study on the Awareness and Perception of Cryptocurrency in Bangalore authors found that people, in general, are aware of the Cryptocurrency and they would like to see it as part of their investment portfolio as it provides good return. But they are not willing to invest in Cryptocurrency due to lack of regulation from Government and regulatory authorities (Shukla, S. 2019) [22].

The delayed approach from the government and the central bank is turning out to be costly for crypto investor as Indian entrepreneurs are moving their base to the crypto-friendly countries to experiment their innovations. However, in India also there have been much discussion about bringing cryptocurrency regulations and law. Furthermore, government of

India and lawmakers are deliberately trying to understand technology instead of making any haste decisions. Bitcoin was the first cryptocurrency proposed in a white paper published in 2008 by a person or a group with the pseudonym of Satoshi Nakamoto and launched in 2009. It did not have much competition back then. In fact, as per coin market cap, it has around 70% market capitalization among all the cryptocurrencies. The main enticing property of this newly invented cryptocurrency was that it was fully decentralised. It became a new investment alternative among the investors as its prices fluctuated from $0.01 to $250 within a four-year time span (Deepika, *et al*., 2017) [8].

Bitcoin became a new mode of payment bypassing the traditional currencies as it had low transaction fees and speed, high liquidity and convertibility, decentralized and secrecy. Well established companies such as Dell, Wordpress.com, Subway, Microsoft, Steam and the internet archive started accepting them as new payment method (Deepika, *et al*., 2017) [8]. Apart from this people are using this system to make real time payments and allow business to use consumption of their products such as cell phones, audio, video utility services and so on (Wolfgang *et al*., 2020) [25].

For numerous reasons, the market of bitcoin and rival cryptocurrencies is worth studying. First and foremost, it was a totally new market with several firms arriving and competing. It's also a fantastic laboratory, with well-defined and high-quality data on pricing and volumes across time. Therefore, this study examines various variables to evaluate the factors that impact Bitcoin prices, including the INR/USD exchange rate, gold prices, crude oil prices, NYSE DJ prices, NIFTY prices, and SENSEX prices, as well as 9 altcoin values. Many earlier research regarded NIFTY and SENSEX, Indian stock market indices, as potential variables influencing cryptocurrency values.

Literature Review

The advancement of blockchain technology has allowed cryptocurrency to infiltrate the financial sector to a certain extent by offering an alternative monetary system with additional benefits like as reduced transaction costs, significantly faster processing, and a better level of anonymity. Bitcoin is the cryptocurrency industry's first totally decentralised digital money.

For the first time, Bitcoin is a kind of electronic payment that allows the user to validate digital assets without relying on third party. This is accomplished by combining public key cryptography, peer-to-peer networking, and a proof-of-work technique.

Thousands of cryptocurrencies and a host of other blockchain-based apps are widely available more than a decade later Because of its decentralised structure, investors may control their money without relying on businesses, banks, or the government (Härdle, Harvey, & Reule, 2020) [14].

Most cryptocurrencies' supply grows at a pre-set pace that cannot be altered by any central body. In the case of Bitcoin, there are now around 15 million Bitcoins in circulation, with the total amount eventually reaching 21 million. Because of its restricted supply in absolute numbers, this raises worries about the currency's deflationary potential (Gandal & Halaburda, 2016) [12].

Bitcoin has indeed lately been a topic of study in finance and economics. For a long time, financial investors have been interested in this issue. A tiny number of theoretical papers authored by a small number of scholars and academics examine elements that are important in establishing Bitcoin pricing. Following is the table representing variables or factors that influence various cryptocurrency prices are studied.

Table 1: Representing various determinants/factors/variables undertaken by various studies in literature. (Source: Author compiled from various sources)

Study	Variables/Determinants/Factors	Research Techniques
The Effects of Gold, Stock Markets and Geopolitical Uncertainty on Bitcoin Prices and Volatility (Kyriazis, 2020) [19]	Geopolitical Risk Index Gold VIX index Bitcoin	Correlation matrix
On the determinants of bitcoin returns: a LASSO approach (Panagiotidis, *et al*., 2018) [21].	Stock Market Returns, Exchange Rates, Gold And Oil Returns, FED's and ECB's rates and Internet Trends Bitcoin Returns GOOGLE GOLD CEPU ECB DFR DJ VXD EEPU WIKI- EFFR JPY/USD USEPU CNY/USD OIL SSEC SP350	Least Absolute Shrinkage and Selection Operator (LASSO) Regression

	USD/EUR NIKKEI WIKI+ GBP/USD NASDAQ	
What are the main drivers of the Bitcoin price? Evidence from wavelet coherence analysis. (Krištoufek, 2015) [17].	Bitcoin price index (BPI) BlockChain Total bitcoins in circulation • Number of transactions excluding exchange transactions • Estimated output volume • Trade volume vs. transaction volume ratio • Hash rate • Difficulty Exchanges • Bitfinex, • Bitstamp, • BTC-e and • Mt. Gox • CNY market The Financial Stress Index Gold	Wavelet coherence for correlations
BitCoin meets Google Trends and Wikipedia: Quantifying the relationship between phenomena of the Internet era. (Kristoufek, 2013) [16]	BitCoin Returns Google Trends (returns), Wikipedia (returns),	Stationarity & cointegration. linear correlation
Examining Bitcoin and Economic Determinants: An Evolutionary Perspective (Vo, *et al*., 2022) [24].	**Log-transformed indicators** • Close (Bitcoin) • GDP (Gross Domestic Product) • T5YIFR (5 Year Forward Inflation Expectation Rate) • DGS10 (10-year T-bond interest rate) • FEDFUNDS (Effective Federal Funds Rate) • VIXCLS (CBOE Volatility Index) • SP500 • Gold Price • Crude Oil Price	Ordinary Least Squares (OLS) regression analyses. OLS prediction results with MSE and MAE.
Bitcoin is not the New Gold–A comparison of volatility, correlation, and portfolio performance. (Klein, *et al*., 2018) [15].	Bitcoin Gold Silver WTI (West Texas Intermediate) Equity Indices • S&P 500 • MSCI World • MSCI EM50	Unconditional pairwise Pearson correlation Matrix
Bitcoin, gold and the US dollar–A replication and extension (Baur, *et al*., 2018) [5].	Bitcoin USD/EUR USD/GBP USD FX Index EUR FX Index FTSE 100 MSCI World Gold Cash Gold Future	correlation analysis
Determinants of Cryptocurrency Market: An Analysis for Bitcoin, Ethereum and Ripple. (Deniz, & Teker, 2020) [10].	Natural Logarithms of • Brent Oil • Gold • Bitcoin • Ethereum • Ripple	Johansen Cointegration Test and Granger Causality Test
Quantifying the cross-correlations between online searches and Bitcoin market. (Zhang, *et al*., 2018) [26]	Bitcoin Returns Change of Google Trends	cross-correlation test

	• CGT-returns • and CGT-volume	
Factors affecting cryptocurrency prices: Evidence from ethereum. Angela & Sun, 2020) [2]	Ethereum Bitcoin (BTC), Ripple (XRP), Stellar (XLM), Litecoin (LTC) and Monero (XMR). Gold EUR/USD	Correlation
Exploring the dynamic relationships between cryptocurrencies and other financial assets. (Corbet, *et al*., 2018) [7].	Bitcoin, Ripple and Litecoin. MSC GSCI Total Returns Index, the US$ Broad Exchange Rate, the SP500 Index and the COMEX closing gold price, VIX and the Markit ITTR110 index	Correlation
Can volume predict Bitcoin returns and volatility? A quantiles-based approach. (Balcilar, *et al*., 2017) [3].	Natural logarithm • Bitcoin Prices • Traded volume	causality-in-quantiles test
Factors Influencing Cryptocurrency Prices: Evidence from Bitcoin, Ethereum, Dash, Litcoin, and Monero (Sovbetov, 2018)) [23]	Crypto Related Factors • Market Beta, • Trading Volume • Volatility SP500 index	Cointegration, Error Correction Model
Can we predict the winner in a market with network effects? Competition in cryptocurrency market. (Gandal & Halaburda, 2016) [12]	Natural logarithm • Bitcoin (BTC), • Litecoin (LTC), • Peercoin (PPC), • Namecoin (NMC), • Feathercoin (FTC), • Novacoin (NVC) • Terracoin (TRC).	Correlation Regression
Bitcoin return: Impacts from the introduction of new altcoins. (Nguyen, *et al*., 2019) [20]	Bitcoin Return Bitcoin Supply Bitcoin Demand Gold Price NASDAQ Oil Price Yuan/USD USD/EUR	Correlation
The asymmetric effect of bitcoin on altcoins: evidence from the nonlinear autoregressive distributed lag (NARDL) model. (Demir, *et al*., 2021) [9].	Bitcoin Ethereum (ETH), Ripple (XRP) Litecoin (LTC) Oil price, gold price, 10-year treasure maturity rate, USD/EUR parity, and Nasdaq Composite Index	cointegration
The relationship between Bitcoin returns and trade policy uncertainty. (Gozgor, *et al*., 2019) [13].	returns of Bitcoin index of trade policy uncertainty (TPI) in USA	Correlation Causality Test

After discussion, it can be inferred that very few of these works analyse cryptocurrency competition, and none of the studies integrate NIFTY and SENSEX, Indian stock market indexes of the NSE (National Stock Exchange) and the BSE (Bombay Stock Exchange), respectively, as potential predictors of cryptocurrency pricing.

Research methodology

For meeting the objectives, the study undertakes the following:

- **Sample:** This study will take on 10 leading that cumulatively constitute 90.41% of the overall cryptocurrency based on market capitalization. Indian and Foreign financial markets, foreign exchange market, commodity market and cryptocurrencies, namely; SENSEX, NIFTY, NYSE, USD, Crude oil, Gold, Binance coin, Bitcoin cash, Bitcoin SV, Bitcoin, EOS, Ethereum, Litecoin, Monero, Tether and Ripple. Sensex and Nifty are the indicators of Indian stock market and NYSE is for US financial market.

- **Time Frame:** The sample period will be collected from 7 October, 2015 to 29 April, 2020. The selected cryptocurrencies are based as per top 10 market capitalization on August 2018 on coin market cap.

- **Data:** Data is natural logarithms of daily closing price of selected variables.

- **Sources:** The study will be based on secondary source collected from Coinmarketcap.com, coindesk.com, bitcoincharts.com, bitfinex.com and tokendata.io, etc. For daily closing price of gold, and foreign exchange

rate, the secondary data will be collected from Yahoo Finance, Bloomberg currency database and money control, etc and exported to EVIEWS software.

- **Techniques:** This study is conducted in EVIEWS software, correlation matrix and OLS regression is applied the selected data. Prior to that, descriptive statistics shows the Jarque-Bera test of normality. The test helps identify whether the variables are normally distributed or not.

Data analysis and interpretation

We examine how currency prices changed over time between FY 2015 to FY 2020 and how these adjustments influence with bitcoin prices. To conduct further analysis natural logarithmic tranformations are performed to convert the raw data time series into returns. The dependent variable in this study is the bitcoin because the study wants to analyse the impact of other determinants on bitcoin pricing.

To perform the regression analysis, the study has conducted Jarque- Bera test of normality as shown in the table 2 representing descriptive statistices of 16 selected time series data from FY 2015 to FY 2020.

The Ho for the Jarque-Bera test is that underlying returns of time series is normally distributed.

Table 2: Representation of Descriptive statistics of Returns of 16 Selected Time series. (Source: Author compiled from EVIEWS output)

	BINANCE ...	BTC CAS...	BTC RET...	BTC SV R...	EOS RET...	ETHEREU...	LITECOIN ...	MONERO ...	TETHER ...	XRP RET...	CRUDE R...	GOLD RE...	USD RET...	NYSE DJ ...	NIFTY_RE...	SENSEX ...
Mean	1.282924	0.342158	0.429499	0.846639	0.680406	0.721473	0.474249	0.760597	0.002276	0.684159	0.596435	-0.036412	0.012886	-0.002348	0.027005	0.029037
Median	0.000000	-0.407747	0.295052	-0.391341	0.000000	-0.055042	0.000000	-0.011339	0.000000	-0.308280	0.127470	-0.039863	-0.005209	-0.060113	0.044506	0.053241
Maximum	138.5744	53.96913	23.60706	142.4941	168.3168	49.88619	64.20048	79.43396	5.882353	179.3669	837.1429	5.012469	2.980422	13.42259	8.763210	8.974906
Minimum	-38.61985	-37.20303	-34.26764	-38.94809	-37.19807	-38.25613	-31.08853	-33.06228	-5.862196	-46.00468	-90.83170	-7.098640	-1.853923	-9.121052	-12.98047	-13.15258
Std. Dev.	11.59027	9.481685	4.908231	13.39800	11.46795	7.463376	7.106007	8.542969	0.675300	10.28059	25.20159	0.924820	0.439330	1.208795	1.119374	1.124904
Skewness	4.725110	1.340045	0.001001	4.698912	5.111113	0.800427	2.271176	2.116832	0.340557	7.273213	32.27885	-0.424711	0.603336	1.946257	-1.382055	-1.357209
Kurtosis	46.14456	10.21125	8.890170	44.12162	70.45693	8.279842	19.27767	17.92735	22.22474	104.6327	1073.617	10.22477	7.343837	32.25495	29.36501	30.72918
Jarque-Bera	54783.82	1748.425	1637.851	26541.32	134023.2	1436.997	13482.49	11365.40	17469.65	497614.0	54307873	2498.211	959.5084	41118.64	33175.85	36646.66
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	864.6909	242.5904	486.6228	303.0967	470.1605	817.4294	537.3239	861.7569	2.578391	775.1525	675.7610	-41.25530	14.59976	-2.659821	30.59714	32.89854
Sum Sq. Dev.	90407.05	63650.86	27270.71	64083.79	90744.58	63054.65	57160.72	82615.98	516.2260	119641.7	718956.2	968.1896	218.4885	1654.063	1418.395	1432.444
Observations	674	709	1133	358	691	1133	1133	1133	1133	1133	1133	1133	1133	1133	1133	1133

From table 2, the probability is less than 0.05 hence we fail to reject the Ho for the Jarque-Bera test for normality which indicates that time series are normally distributed. Hence the returns of Bitcoin, Binance coin, Bitcoin cash, Bitcoin SV, EOS, Ethereum, Monero, Litecoin, Tether, XRP, Gold, Crude, INR/USD, NYSE, NIFTY and SENSEX are normally distributed at confidence level of 95% and 99%.

Results

To further test the impact of selected time series on the Bitcoin prices, we perform the OLS regression in the EVIEWS. Table 3 represents the regression results.

Table 3: OLS Regression performed to identify the impact of selected determinants on Bitcoin prices. (Source: Author compiled from EVIEWS Output)

Dependent Variable: BTC_RETURN
Method: Least Squares
Date: 05/13/22 Time: 10:42
Sample (adjusted): 11/06/2018 4/29/2020
Included observations: 358 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.085829	0.125859	0.681950	0.4957
BINANCE_COIN_RETURN	0.034766	0.033325	1.043242	0.2976
BTC_CASH_RETURN	0.007828	0.018840	0.415486	0.6780
BTC_SV_RETURN	0.015320	0.010871	1.409264	0.1597
EOS_RETURN	0.065645	0.046242	1.419596	0.1566
ETHEREUM_RETURN	0.326143	0.055856	5.838983	0.0000
LITECOIN_RETURN	0.043497	0.043534	0.999147	0.3184
MONERO_RETURN	0.276762	0.043934	6.299565	0.0000
TETHER_RETURN	0.443959	0.206483	2.150100	0.0322
XRP_RETURN	0.032248	0.050821	0.634542	0.5262
CRUDE_RETURN	-9.68E-05	0.002829	-0.034226	0.9727
GOLD_RETURN	0.021781	0.127677	0.170599	0.8646
USD_RETURN	0.097056	0.224875	0.431601	0.6663
NYSE_DJ_RETURN	-0.138304	0.141711	-0.975953	0.3298
NIFTY_RETURN	0.040769	0.127531	0.319683	0.7494
SENSEX_RETURN	-0.153938	0.124906	-1.232434	0.2186

R-squared	0.781605	Mean dependent var	0.178597
Adjusted R-squared	0.772027	S.D. dependent var	4.928708
S.E. of regression	2.353289	Akaike info criterion	4.593168
Sum squared resid	1893.985	Schwarz criterion	4.766599
Log likelihood	-806.1770	Hannan-Quinn criter.	4.662142
F-statistic	81.59814	Durbin-Watson stat	1.836909
Prob(F-statistic)	0.000000		

From the table 3, it can be interpreted that the dependent variable, Bitcoin, is significantly effected by Ethereum, Monero and Tether as their significance value is less than 0.05, ie, 0.00 for Ethereum and Monero and 0.03 for Tether. Rest other independent variables do not have significant impact on prices of Bitcoin.

Furthermore, the coefficient value of Ethereum indicates that with 1% increase in the Ethereum prices then there will be 0.326% increase in the bitcoin prices. If there is 1% increase in the Monero prices, the bitcoin will rise by 0.27% and lastly if Tether is increasing by 1% then bitcoin will also rise by 0.44%.

The value of R square is 0.78, adjusted R square is 0.77 and F statistic probability is also significant indicating that model is a good fit. The value of Durbin-Watson statistic is 1.83 which is near to 2, hence there is no serial autocorrelation the data.

Conclusion

The purpose of this study is to examine the impact of macroeconomic factors such as Indian and foreign financial markets, foreign exchange markets, commodity markets, and cryptocurrencies, specifically the SENSEX, NIFTY, NYSE, USD, Crude oil, Gold, Binance coin, Bitcoin cash, Bitcoin SV, Bitcoin, EOS, Ethereum, Litecoin, Monero, Tether, and Ripple. The Sensex and Nifty were based on Bitcoin prices using the OLS Regression technique from FY 2015 through FY 2020.

The study concludes that the dependent variable, Bitcoin, is significantly affected by Ethereum, Monero and Tether. Rest other independent variables do not have any significant impact the Bitcoin prices. These results are in the line with Corbet, *et al*. (2018) [7], Baumöhl (2019) [4] and Ciaian, *et al*. (2018) [6]. This study plays significant role for the investors in Bitcoin and other cryptocurrencies. It will help them analyse the market more accurately. Also, there is no previous researches that attempted to identify the impact of Indian Stock market indices, NIFTY and SENSEX on the Bitcoin. So, this study is new and significant addition to the available literature.

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