

Are Economic Factors Driving BitCoin Transactions? An Analysis of Select Economies

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Abstract

New league of economy and economics are evolving with the flourishing of crypto currencies based on block chain technology that's going to control the production, distribution and consumption of online products and services in a decentralized digital economy. BitCoin, is the most popular among them and BitCoin transaction volume was 300,504 transactions on 28th April 2017. BitCoin—or “BTC”, this decentralised crypto currency has ignited much research attempts in the recent past and has drawn exponential number of users using it as a medium of exchange in the digital trade platforms. This study is making an attempt to analyse some empirical evidences across the globe and seeking to decipher the underpinning role of increasing volume of BitCoin to various economic indicators of select countries. Key economic factors identified for the investigation are inflation, internet penetration, financial openness, and how these drivers are driving its growth and value. Is there any significant relationship between the constructs? Are these economic indicators are driving the surging trade volume of this leading global cryptocurrency in the digital economy. These questions are analysed based on the published sources and presents researchers' views to non-technical audience. Six countries are identified and selected for the study. Samples are selected based on the trade volume; market share of BitCoin transaction in the currencies selected countries. Sample countries/currencies selected for the purpose are, United States, Canada, Russia, Brazil, China and South Africa. Results of correlations, regression and ANOVA analysis, indicates that the variables analysed do not significantly affects the trade volume of BitCoin.

Key Words: *BitCoin, digital economy, block chain technology inflation, internet penetration, financial openness*

1. Introduction

Last decades witnessed the emergence of multitudes of cryptocurrencies, which were transacted in digital economy. This flourishing is attributed mainly to the advancement of block chain technology. The unique characteristics of these crypto currencies are that it works on a decentralized peer-to-peer network platform (Nakamoto, 2008). Decentralised means no central administrator to regulate its functioning like a central bank in the conventional currency system (Antonopoulos & Andreas, 2014). Gradually, these currencies, is evolved as a popular mode of payment in digital economy. A new subclass of economics, digital economy, is thus emerged with the rise of crypto-economics. Digital economy is termed as “a formal discipline that deals with protocols that governs the production, distribution and consumption of goods and services in a decentralized digital economy. The crypto-economy is an “economic system, which is not defined by geographic location, political structure, or legal system, but which uses cryptographic techniques to constrain trade behavior in place of using trusted third parties” (Babitt and Dietz, 2014). Crypto economics is a practical science that focuses on the design and characterization of these protocols” (Zamfir, 2015). In classical Economic theory, the value of a currency is determined in a conventional economy by the invisible forces of demand and supply. This is technically known as price mechanism and under this approach prices are determined purely based on the interplay between market mechanism of demand and supply. Price will be fixed at equilibrium point where demands equate supply ($D=S$). Any price other than this equilibrium point does not last in long run. The prices of currency not only depends on micro factors of market demand and supply, consumer behaviour, quality of the commodity(currency), price of related currency, consumer’s expectation on future price changes but also macro factors. BitCoin has been emerged as NextGen digital among many cryptocurrencies in the wake of voluminous digital economy.

1.1 Back Ground of BitCoin- A Cryptocurrency

Crypto Currency is an electronic decentralized monetary system created on network of computers and exchanges on peer-to-peer networking system based on the epistemology of cryptography to maintain its integrity (4). It is created in a process called “mining” (Plassaras 2013; CoinDesk 2015c). In which the network participants using their computing power, verify and record payments into a public ledger called block chain. In return to this service, the miners receive transaction fee and a newly minted Bit Coin. A fixed amount of BitCoin is issued at a constant a-priori defined and publicly known rate, thus the stock of BitCoin increases at a decreasing rate. According to the algorithm, in the year 2140, the growth rate of BitCoin will touch to zero, when the maximum amount of BitCoin in circulation are mined to 21 million units and it will not change after 2140. Thus the BitCoin, as a currency has finite supply. Though mining is the primary way that users acquire Bit Coin, but there are other

ways also to acquire BitCoin without complicated mining process. People can acquire Bit Coin with Fiat currency from Bit Coin agents or from someone who has it and willing to sell it. Another way to acquire BitCoin is to sell a product or service in exchange for BitCoin. There are some IT companies that pay their workers in BitCoin and some freelance software developers that request to be paid in BitCoin

A Crypto currency is exchanged and each transaction, a transaction log is distributed across a network of participating computers using block chain technology (Bohme, Rainer.2015).BitCoin, created in 2009, (Nakamoto, 2008) is the leading cryptocurrencies and is the most popular among all and is widely circulated to date in terms of volume and value. BitCoin are denominated in their own numerations: each BitCoin (BTC) is subdivided into 100 million smaller units called satoshis, defined by eight decimal places. The unique characteristics of BitCoin are that it works on a decentralized peer-to-peer network platform. Decentralised means no central administrator to regulate its functioning like a central bank in conventional currency system (Antonopoulos & Andreas, 2014).A customer, who would like to use BitCoin as a payment mode for virtual transaction, will first acquire a “*BitCoin wallet*” through one of the sites/agents who are engaged in the buying and selling crypto currencies. Each wallet is linked with one or more addresses like an email address and allow anyone to send or receive money from anywhere in the globe any time (Krause, 2016). Every wallet has a secret key like a password that allows access to the BitCoin stored within the wallet. Then, the potential customers have to transfer the required funds from his normal bank account to this wallet, which then could later be used to buy BitCoin. The purchased BitCoin can be stored in the wallets, on your desk-top or mobile, or in the cloud until put to use. These coins can be used to buy products and services from merchant websites. Transfers from BitCoin wallets are affected using QR codes installed in a smartphone and with a BitCoin Wallet app, with which the customer can scans a label and press a button named as “*spend*”. There is continuous growth of companies accepts Bit Coins as a payment mode and several have included BitCoin as a payment mode in the payment options on their websites for their goods and services and more than 100000 websites accepts BitCoin in the beginning of 2015(Cuthbertson 2015). According to the developers of BitCoin, the supply of BitCoin is finite. The maximum numbers of Bitcoins that are to be mined till 2030 are limited to 21 Million.

Price of BitCoin has surged exponentially during the last three years. The price of BitCoin has increased from \$5 in 2011 to \$1,140 in January 2017, resulted an increase of 22800%. This sort of price formation is uncommon and volatility is unusual for conventional currencies. This rare phenomenon suggests that there can be specific factors that drive price

volatility of digital currencies. The present study was undertaken to understand the underlying factors causing price rise and the consequent higher trade volume of BitCoin.

3. Objectives of the Study

To examine the impact of macro-economic factors on the price of BitCoin traded in the selected country's currency. The specific factors considered are inflation, financial openness and internet penetration of a country. The objective focuses on the following three questions:

1. Is there any impact of financial openness on the change in the price of bitcoin?
2. Is there any impact of internet penetration on the change in the price of bitcoin?
3. Is there any impact of inflation on the change in the price of bitcoin?

4. Review of Literature

BitCoin has attracted much research interest to date since the inception of BitCoin as a currency in 2008. (Grinberg 2011; Barber et al. 2012; Kroll, Davey, and Felten 2013; Moore and Christin 2013; Bouoiyour, Selmi, and Tiwari (2014); implication of BitCoin for developing world (Krause ,2016) and economic aspects of BitCoin price like (Buchholz et al. 2012; Kristoufek 2013; van Wijk 2013; Bouoiyour and Selmi 2015). Several factors affecting BitCoin price have been identified as market forces of BitCoin supply and demand (Buchholz et al. 2012; Bouoiyour and Selmi 2015); BitCoin attractiveness for investors (Kristoufek 2013; Bouoiyour and Selmi 2015); and global macro-financial development (vanWijk 2013), economics of price formation(Ciaiana et.al.2016). Our paper is trying to study how inflation, internet penetration, and financial openness are affecting the price and the consequent trade volumes of BitCoin.

Review of existing literature of (e.g. Buchholz et al. 2012; Kristoufek 2013; van Wijk 2013; Bouoiyour and Selmi 2015), recommend three types of drivers determining BitCoin price formation: (i) market forces of BitCoin supply and demand, (ii) BitCoin attractiveness, and (iii) global macroeconomic and financial developments.

According to Buchholz et al. (2012), one of the key drivers of BitCoin price is the interaction between BitCoin supply and demand on the BitCoin market. The BitCoin supply is determined by the total stock of BitCoin in circulation and the BitCoin demand is represented by the size of BitCoin economy (i.e. its use in exchanges) and the velocity of BitCoin circulation. The BitCoin velocity measures the frequency at which one unit of BitCoin is used for purchase of goods and services. The quantity theory implies that the price of BitCoin decreases with the velocity and the stock of BitCoin, but increases with the size of BitCoin economy and the general price level.

Kristoufek (2013), the price creation of BitCoin cannot be explained by traditional economic theories because several determinants of price creations in the conventional theories are absent in BitCoin markets and thus its price cannot be determined by considering

traditional factors of supply and demand like purchasing power parity, future cash flow model and interest rate. This study reveals that since BitCoin markets are not centrally regulated and have traditional real economy and thus standard price formation factors are not applicable for digital currencies traded in digital economy.

Another finding by Bouoiyour and Selmi (2015) also substantiates the findings of Kristoufek (2013), that the BitCoin are devoid of macroeconomic fundamentals of real economy and rather behaves as a 'speculative bubble'. And major factors influencing its prices are of speculation (dubious as investors 'attractiveness) to BitCoin and not drivers like market forces of supply and demand.

Van Wijk (2013) postulated that the global macro financial developments such stock exchange indices, exchange rates and oil prices are influencing price formation of BitCoin. He studied three variables Dow Jones index, the euro-dollar exchange rate and oil price and found that they have a significant impact on the value of BitCoin in the long run.

Pavel, Rajcaniova & Kancs (2016) studied price formation by considering both traditional price determinants of market supply and demand and Bit Coin specific factors BitCoin attractiveness for investors and users. An analysis based on daily data for five years (2009–2015) and applying time-series analytical mechanisms, they found that market forces and BitCoin attractiveness for investors and users have a significant impact on BitCoin price but with variation over time. Thus, they do not agree with the previous findings that macro financial developments are driving price in the long run.

5. Research Gap

Thus, previous literatures on BitCoin show that the price formation is mainly studied from the point of view of standard currency price mechanism. BitCoin being a decentralised cryptocurrency needs an evaluation from different perspective. Though the previous studies have analysed BitCoin specific determinants like speculation (as investor's attractiveness) affects Bit Coin prices in short & long run. Mostly reviews are tends to confirms that market forces of BitCoin's supply and demand have direct impact on BitCoin price and their importance tends to increase over time.

6. Methodology

This is an empirical investigation to identify and describe key selected macroeconomic drivers influencing surging BitCoin transaction volume. The study investigated the price drivers in a different perspective focusing on trade volumes instead of prices. The economic factors considered here are inflation, financial openness and internet penetration of six major countries where the volumes of transactions are huge considered for the study. Samples are selected based on the trade volume; market share of BitCoin transaction in the currencies of selected countries. Although it is not easy to attribute BitCoin trading to geolocate,

transactions involving a fiat currency are considered for the purpose of our analysis. Sample countries/currencies selected for the purpose are, United States, Canada, Russia, Brazil, China and South Africa. Parts of the data, such as economic indicators of select countries, are also sourced from World Bank databases. Data are also collected from Fiatleak, another website, tracks the transaction volume and value online provides data on transactions. The data on the BitCoin transaction volume are collected from Cryptocompare and BitCoiny. Area of our focus is on 15year average values of each of the economic indicators for the analysis. SPSS v20 is used to analyze the data. In order to test the significance of these variables, we used secondary data from possible sources which is analysed using regression techniques. Regression analysis are conducted to understand how independent variable of price of bitcoin is related to the dependent variables and to find out the forms of their relationships. This analysis, in restricted circumstances, can establish causal relationship between the price of bitcoin and macro-economic factors.

As the data of BitCoin transaction volume is available for a few years, it is relatively difficult analyze the volume against economic indicators and draw conclusions. Even though BitCoin transactions are said to have been recorded in public ledgers; it is hard for a common man to access such data. In addition, the data on transaction volume is disclosed on the public domain, however, it is hard to check authenticity of such transaction and confirm that they have actually happened. It is most appropriate to have data of BitCoin transaction volume and data of independent variables of the countries or currencies in order to establish relationship between volume and the economic indicators. It would be highly difficult to say that the transactions happened in a particular currency does belong to a particular country. However, the data sourced from websites have disclosed that the volume of transactions was attributed to the countries. The number of transactions need not correspond to the amount of BitCoin or currencies of the countries.

7. Results and Discussion

The objective of our empirical analysis is to examine what are major indicators that drive BitCoin transactions in the real world. The BitCoin transaction volume figures are regressed against major economic factors to extract conclusions. The three most important factors considered for the study are financial openness, internet penetration and inflation. Table 1.1 shows the aggregated data of variables from different websites.

All the indicators are measured in percentages of the sample countries. The inflation rate variable is the percentage of annual inflation of the countries in scope. Internet penetration is the percentage of population having access to internet whereas financial openness is also expressed as the percentage of willingness of the nation to adapt to a new financial system.

Table 1.1: Bitcoin Transaction Volume & Economic Indicators

	2016 Average Daily Volume	Financial Openness 2014	Financial Openness 15-year Average	Inflation 2015	Inflation 15-year Average	Internet Penetration 2015	Internet Penetration 15-year Average
Brazil	13.0699	-0.1263	-0.0949	7.9699	8.2064	59.0795	33.2441
Canada	41.3420	2.3892	2.3892	-0.5531	2.0216	88.4700	75.5933
China	69.7443	-1.1888	-1.1888	-0.4350	3.7096	50.3000	24.4121
Russia	663.8527	1.1717	0.0548	7.6812	13.4563	73.4100	33.9781
USA	1571.1016	2.3892	2.3892	1.0759	1.9893	74.5500	68.4194
South Africa	131.6499	-1.1888	-1.1888	3.9569	6.8995	51.9191	21.0980

The economic drivers under consideration are tested with correlation and regression to draw conclusions if there is any significant relationship between the dependent and independent variables. SPSS v20 is used to analyze the data and the analysis and conclusions were tabulates in Table 1.2.

Table 1.2: Correlations

Variable		2016 Average Daily Volume	Financial Openness 2014	Financial Openness 15-year Average	Inflation 2015	Inflation 15-year Average	Internet Penetration 2015	Internet Penetration 15-year Average
2016 Average Daily Volume	Pearson Correlation	1	.581	.530	-.068	-.120	.336	.439
	Sig. (2-tailed)		.227	.279	.898	.820	.515	.384
	N	6	6	6	6	6	6	6
Financial Openness 2014	Pearson Correlation	.581	1	.961**	-.195	-.249	.953**	.926**
	Sig. (2-tailed)	.227		.002	.711	.634	.003	.008
	N	6	6	6	6	6	6	6
Financial Openness 15-year Average	Pearson Correlation	.530	.961**	1	-.348	-.479	.898*	.988**
	Sig. (2-tailed)	.279	.002		.499	.336	.015	.000
	N	6	6	6	6	6	6	6
Inflation 2015	Pearson Correlation	-.068	-.195	-.348	1	.888*	-.193	-.470
	Sig. (2-tailed)	.898	.711	.499		.018	.715	.347
	N	6	6	6	6	6	6	6
Inflation 15-year Average	Pearson Correlation	-.120	-.249	-.479	.888*	1	-.182	-.576
	Sig. (2-tailed)	.820	.634	.336	.018		.730	.232
	N	6	6	6	6	6	6	6

Internet Penetration 2015	Pearson Correlation	.336	.953**	.898*	-.193	-.182	1	.888*
	Sig. (2-tailed)	.515	.003	.015	.715	.730		.018
	N	6	6	6	6	6	6	6
Internet Penetration 15-year Average	Pearson Correlation	.439	.926**	.988**	-.470	-.576	.888*	1
	Sig. (2-tailed)	.384	.008	.000	.347	.232	.018	
	N	6	6	6	6	6	6	6
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

The correlation between the transaction volume and the variables is insignificant. Among all the variables, financial openness is the one which can be said to be distantly related. However, each independent variable is regressed and tested to verify the result.

Evaluation of financial openness is strenuous owing to numerous reasons. There could be a chance that the numbers of financial openness can artificially be inflated if a country exercises controls on capital in the absence of formal policies to implement them. In order to overcome this drawback, a noteworthy way of measuring financial openness was brought in by Minzie Chinn and Hiro Ito, KAOPEN index, wherein existence of restrictions on transactions happening, existence of exchange rates and existence of any surrender of export proceeds. The index number of financial openness corresponds and indicates the level of willingness of a country towards capital account openness, i.e., in adopting policies in the process of improving its trade and commerce. Two different variables for financial openness are considered for the analysis; most recent available financial openness data point and 15 year average financial openness data.

Regression 1

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	660720.306	2	330360.153	.800	.527 ^b
	Residual	1238435.057	3	412811.686		
	Total	1899155.363	5			
a. Dependent Variable: 2016 Average Daily Volume						
b. Predictors: (Constant), Financial Openness 15-year Average, Financial Openness 2014						

Coefficients					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	269.588	296.889		.908	.431

Financial Openness 2014	348.391	629.367	.934	.554	.618
Financial Openness 15-year Average	-138.683	637.024	-.367	-.218	.842
a. Dependent Variable: 2016 Average Daily Volume					

Financial openness proves that the relationship between the BitCoin transaction volume and the financial openness is insignificant at the 0.05 level. An increase in financial openness by one unit leads to a 0.934 increase in log transaction volume or a 154.46% increase in transaction volume, all else equal.

The historical financial openness is much far when compared against the recent financial openness figures. This implies that the recent change in the openness of countries to capital account is contributing more to the growing transaction volumes.

The second regressor for our analysis is internet penetration, which is considered as one of the leading factors for increasing BitCoin transaction volume. The internet penetration rates used in this analysis were taken from World Bank data sources. The internet penetration variable represents the people having access to the internet. The two variables used are the annual internet penetration rate in 2015 and the average annual internet penetration rate over the past 15 years.

Regression 2

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	392842.343	2	196421.171	.391	.706 ^b
	Residual	1506313.021	3	502104.340		
	Total	1899155.363	5			
a. Dependent Variable: 2016 Average Daily Volume						
b. Predictors: (Constant), Internet Penetration 15-year Average, Internet Penetration 2015						

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	359.202	2029.184		.177	.871
Internet Penetration 2015	-10.565	45.986	-.257	-.230	.833
Internet Penetration 15-year Average	17.673	29.630	.668	.596	.593
a. Dependent Variable: 2016 Average Daily Volume					

The relationship between internet penetration and the transaction volume of BitCoin is insignificant at the 0.05 level. The relationship between internet penetration and the transaction volume of BitCoin is insignificant at the 5% level. An increase in the internet penetration by one unit leads to a -0.257 increase in log transaction volume, all else equal.

The same results are observed when 15-year average internet penetration is used in place of 2015 internet penetration. However, there is much variation between the results in the transaction volume between the recent numbers and historical average numbers of internet penetration. These results are counterintuitive as there could be a significant historical precedent driving BitCoin transaction volume.

Finally, the third regressor for our analysis is inflation which is assumed as one of the leading drivers of BitCoin transaction volume. To measure the correlation between inflation and the BitCoin transaction volume, the percentage of the inflation was included as one of the regressors. The two variables used are the annual inflation rate in 2015, and the average annual inflation rate over the past 15 years. The data for this variable was gathered from the Global Financial Inclusion Database published by The World Bank.

Regression 3

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40937.297	2	20468.648	.033	.968 ^b
	Residual	1858218.067	3	619406.022		
	Total	1899155.363	5			
a. Dependent Variable: 2016 Average Daily Volume						
b. Predictors: (Constant), Inflation 15-year Average, Inflation 2015						

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	557.179	640.881		.869	.449
	Inflation 2015	29.040	197.287	.183	.147	.892
	Inflation 15-year Average	-39.255	172.423	-.283	-.228	.835
a. Dependent Variable: 2016 Average Daily Volume						

It can be seen that the regressors are not significant at 5% level. When looking at the inflation, it is seen that a one-percentage-point increase in the inflation rate in 2015 leads to a 0.183 increase in log transaction volume. When the log is transformed ($\exp(0.183)-1$), a one-percentage-point increase in the inflation leads to a 20.08% increase in the transaction volume

in 2015 holding all else equal. This large coefficient shows that inflation doesn't just have a statistically significant impact on BitCoin volumes but also a large economically significant impact. This implies that BitCoin is in fact being used as a saving haven for those confined to inflationary currencies and that a small increase in inflation can lead to a profoundly large increase in BitCoin transaction volume.

Interestingly the significance decreases dramatically when using the historical inflation and historical internet penetration in regression. When the 15-year average inflation rate is used instead of the rate for 2015 the coefficient becomes insignificant.

Historical inflation and internet penetration in a country were expected to have much larger impact on people's skepticism of government monetary policies than the most recent values for each of those measures. The regressions show, however, that recent numbers for both of these variables are much more influential in determining BitCoin transaction volume. One possible reason for this trend is that BitCoin users are mostly tech-savvy and therefore younger and haven't had to deal with past inflation or financial restrictions.

Finally, a conclusion can be drawn from the above analysis that none of the selected economic indicators are driving the BitCoin transaction volume. The financial openness is the only factor among the three may be the remote driving factor for the transaction volumes. There must be other factors that are responsible for the growing transaction volume which need further analysis

8. Conclusions and Recommendations

Recently, there are number of research attempts to understand the phenomenal growth of BitCoin in general and the factors that drives its high volatility in price and volume in particular. Researchers attribute number of reasons for its exponential prices and steadily increasing trade volume from different perspectives. Few scholars are even poised a doubts about, is it an alternative for fiat currency in future. This paper attempted to analyse the significant relationship between selected three economic indicators viz. financial openness, inflation and Internet penetration with the transaction volumes of select countries. Results of regression analysis of the independent variables prove that none of the selected variables are driving the transaction volume of BitCoin. If at all, there is slight significance, financial openness can be considered as remote driver, but again, which requires further in-depth analysis to establish the relationships. The present study also reiterates facts rose by critics of Bit Coin and termed it as a Ponzi investment. However, the study sheds light into the price determination mechanism of Bit Coin that it should be based on Crypto economic specific factors which needs to be identified and conceptualised in further researches.

References

- Antonopoulos, Andreas M. (2014) *Mastering bitcoin: unlocking digital cryptocurrencies (Sebastopol: O'Reilly Media)*.
- Babbitt, D. & Dietz, J. (2014). Crypto-economic design: a proposed agent-based modelling effort. *Swarm Fest 2014: 18th Annual Meeting on Agent-Based Modelling & Simulation. University of Notre Dame. USA. June 29 – July 1.* [Online] Available from <http://www3.nd.edu/~swarm06/SwarmFest2014/Babbitt.pdf> [Accessed: 5th April 2017]
- Barber, S., X. Boyen, E. Shi, And E. Uzun. (2012.) Bitter to Better-How to Make BitCoin a Better Currency. In *Financial Cryptography and Data Security*. Vol. 7397, of Lecture Notes in Computer Science, edited by, Keromytis, A. D., p.399–414. Berlin: Springer.
- Böhme, Rainer, Nicolas Christin, Benjamin Edelman and Tyler Moore. (2015). "Bitcoin: economics, technology, and governance." *Journal of Economic Perspectives*, 29(2): 213-38. [Online] DOI: 10.1257/jep.29.2.213 [Accessed: 5th April 2017]
- Bouoiyour, J., R. Selmi, and A. Tiwari (2014). Is bitcoin business income or speculative bubble? Unconditional vs. Conditional frequency domain analysis. *MPRA Paper No.59595*. Germany: University Library of Munich.
- Buchholz, M., J. Delaney, J. Warren, and J. Parker (2012). Bits and bets, information, price volatility, and demand for bitcoin, *Economics* 312. [Online] Available from www.BitCointrading.com/pdf/bitsandbets.pdf. [Accessed: 6th April 2017]
- Ciaian P., Rajcaniova, M. and Kancs, D (2014). The Economics of BitCoin Price Formation. *EERI Research Paper Series 2014/08*. [Online] Economics and Econometrics Research Institute, Brussels.
- Coindesk (2015C). How can I buy bitcoin? [Online] Available from: <http://www.coindesk.com/information/what-is-BitCoin>. [Accessed: 20th March 2017]
- Grinberg, R. (2011). BitCoin: An Innovative Alternative Digital Currency. *Hastings Science & Technology Law Journal* 4: 159–208. [Online] [Accessed: 28th March 2017]
- Krause, Makari, (2016). BitCoin: Implications for the Developing World. *CMC Senior Theses*. Paper 1261. [Online] http://scholarship.claremont.edu/cmc_theses/1261. [Accessed: 8th April 2017]
- Kristoufek, L. (2013). "BitCoin meets Google Trends and Wikipedia: Quantifying the relationship between phenomena of the Internet era." *Scientific Reports* 3 (3415): 1-7. [Online] Available from: <https://www.nature.com/articles/srep03415>. [Accessed: 15th April 2017]
- Kroll, J., I. Davey, and E. Felten (2013). The Economics of BitCoin Mining, or BitCoin in the Presence of Adversaries. *WEIS 2013*. [Online] Available from weis2013.econinfosec.org/papers/KrollDaveyFeltenWEIS2013.pdf. [Accessed: 10th April 2017]
- Moore, T., and N. Christin. (2013). Beware the middleman: empirical analysis of bitcoin-exchange risk. *Financial Cryptography and Data Security* 7859: 25–33. [Online] Available from: https://link.springer.com/chapter/10.1007/978-3-642-39884-1_3 [Accessed: 10th April 2017]
- Nakamoto S. (2008) BitCoin: a peer-to-peer electronic cash system. *White paper. Seattle, WA: BitCoin Foundation* [Online] Available from:
- Pavel Ciaian, Miroslava Rajcaniova & D'artiskancs (2016) The economics of BitCoin price formation, *Applied Economics*, 48:19, 1799-1815., [Online] Available from: <https://arxiv.org/ftp/arxiv/papers/1405/1405.4498.pdf> [Accessed: 2nd April 2017]
- Plassaras, Nicholas A. (2013). Regulating Digital Currencies: Bringing Bitcoin within the Reach of the IMF. *Chicago Journal of International Law*, Vol. 14: No. 1, Article 12. [Online] Available at: <http://chicagounbound.uchicago.edu/cjil/vol14/iss1/12> [Accessed on 12th April 2017]

Van Wijk, D. 2013. What can be expected from the BitCoin? *Working Paper No. 345986*. Rotterdam: Erasmus Rotterdam Universiteit. [Online]. Available at: <https://thesis.eur.nl/pub/14100/Final-version-Thesis-Dennis-van-Wijk.pdf> [Accessed on: 13th April,2017]

Zamfir, V. (2015). What is Crypto economics? *Crypto Technology Conference*. Mountain View, CA, USA. January 26-29. [Online]Available at: <https://www.youtube.com/watch?v=91w3s7iGUXQ> . [Accessed on 12th March 2017]