Chapter 15

Bitcoin and the World of Digital Currencies

Asma Salman and Muthanna G. Abdul Razzaq

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.71294

Abstract

A peer-to-peer system of blockchain, originally started for a cryptocurrency Bitcoin, has caused major disruptions in the stock market. It has affected many businesses if not all, but its significance in the financial world is magnanimous. Historical data (daily rates) for the past 23 months are analyzed to understand the market size, market capitalization and price volatility for Bitcoin. Time series data and financial model are applied to realize the shocks. Monte Carlo simulation is applied to assess the dynamic structure of Bitcoin. With greater volume and activity, the banks and financial intermediaries may become outdated, and the middleman will have no place. It seems like a distant thought, but the facts are pointing toward its reality.

Keywords: finance, stock market, cryptocurrencies, Monte Carlo, ADF

1. Introduction

Change is the only *constant* the world witnesses, and it is certainly inevitable. Toward the end of the 1990s, the information technology phenomenon had the world tied together, and the Internet has surely revolutionized the world. Considering it is only 20 odd years old, here comes another paradigm shift in the form of Internet of ***value*** or data technology. The economies around the world are considering, what may be the end of the largest Financial Intermediaries, The Banks! It was a fearful thought but so were the palm tops, where the tech gurus predicted that everyone will be walking around with a computer in their hands. The thought was scrapped by many, but it became a reality sooner than it was predicted. Developed in 2008 by an anonymous under the name of Nakamoto [1], Bitcoin, a cryptocurrency, was introduced to the world. A 'virtual currency' [2], which is defined as any type of digital unit, used as a medium of exchange, a unit of account, or a form of stored value. The idea was close to the gold standard but with an alternative view. To

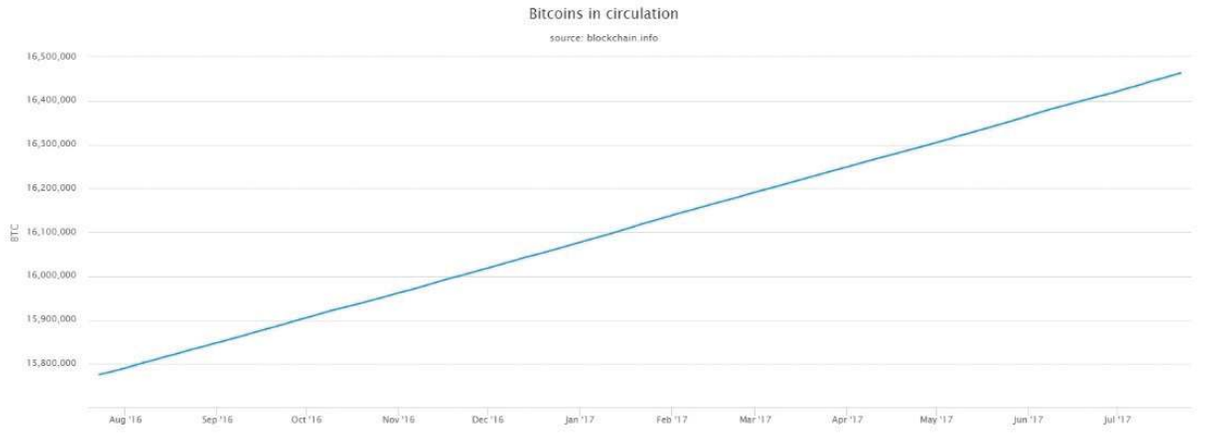

Figure 1. Bitcoin circulation: the mining map.

tackle inflation and its value, Bitcoins have a predetermined number of having 120 million Bitcoins in circulation around the world for the next 25 years. At the moment, 16.5 million Bitcoins [3] have already been mined. So, is this the currency of the world, without having any central authority?

Prominent Market Analysts [4] compare it to the "sharing" economy, which is expected to grow from $15 billion in 2015 to $335 billion by the year 2025, according to a report by PricewaterhouseCoopers. Airbnb, founded in 2008, is a notable player in the sharing economy. The company provides a platform for property owners and visitors to agree and transact short-term rental contracts. While it does not own rental properties, Airbnb today has over 2 million listings in 34,000 cities in 191 countries, generating annual revenue of over $1 billion with a market value of $24 billion.

The decentralized cryptocurrency, Bitcoin, relies on blockchain technology to record its transactions in a public ledger: a technology originally conceived for Bitcoin in 2008 and first implemented in 2009. The blockchain [5] is a distributed database that maintains a continuously growing list of records called blocks secured from tampering and revision. Each block contains a timestamp and a link to a previous block. It serves as the public ledger for all transactions. Every compatible client can connect to the network, send new transactions to it, verify them, and take part in the competition to create new blocks. The competition creating new blocks is known as mining. The Bitcoin design has been the inspiration for other applications and certainly for other cryptocurrencies. If blockchain technology is like metal, then Bitcoin is like gold (**Figure 1**).

2. Cryptocurrencies and the world economy

The last thing on every analyst's mind was Bitcoin surpassing the gold rate. Even the techgurus could not predict it, as gold is a league of its own. A lot was dependent upon the US inflation rates and China's trading opportunities, while political instability being a constant factor. A volatile asset witnessed the making of overnight billionaires in a matter of seconds, when the price jumped from $700 to $2100+. The youngsters, who were merely experimenting with

it, became "accidental millionaires", and history was made. Dash, Doge, Litcoin, PlexCoin, Ethereum and many more cryptocurrencies made their way to the volatile market to leave a mark of their own. While the price of gold remained flat in the last year, there has been an eruption of the virtual currencies while bringing down the fiat currencies. With the market trends going anywhere with prediction, the shift is incorrigible, the facts are surprising and more shocks are due.

A closer look in the historical rates of Bitcoin raises the question about the future of cryptocurrencies. With a surge of supply and demand, analysts are marking the mining to be completed by the year 2041. What needs to be seen is the price volatility post mining. The world changes at the speed of light, they say, the world of technology is even faster, quicker, not only in terms of change but also in terms of implementation. **Figure 2** shows the price volatility in Bitcoin in the US Dollar since Sep 2015. The daily data for the Bitcoin Price Index have been derived from coindesk [6].

Tapscott [7], author of Blockchain Revolution and one of the top most influencers of the world, quoted: *"Ethereum* [8] *blockchain has some extraordinary capabilities. One of them is that you can build smart contracts. It's kind of what it sounds like. It's a contract that self-executes, and the contract handles the enforcement, the management, performance, and payment"*. **Figure 3** shows the price volatility in Ethereum in the US dollar since Sep 2015. The daily data for Ethereum have been derived from coindesk [6].

2.1. The stock market volume and the dollar value

Trading volume is generally reported not only in terms of number of shares but also in terms of the dollar value. These are the two most fundamental figures in the stock market,

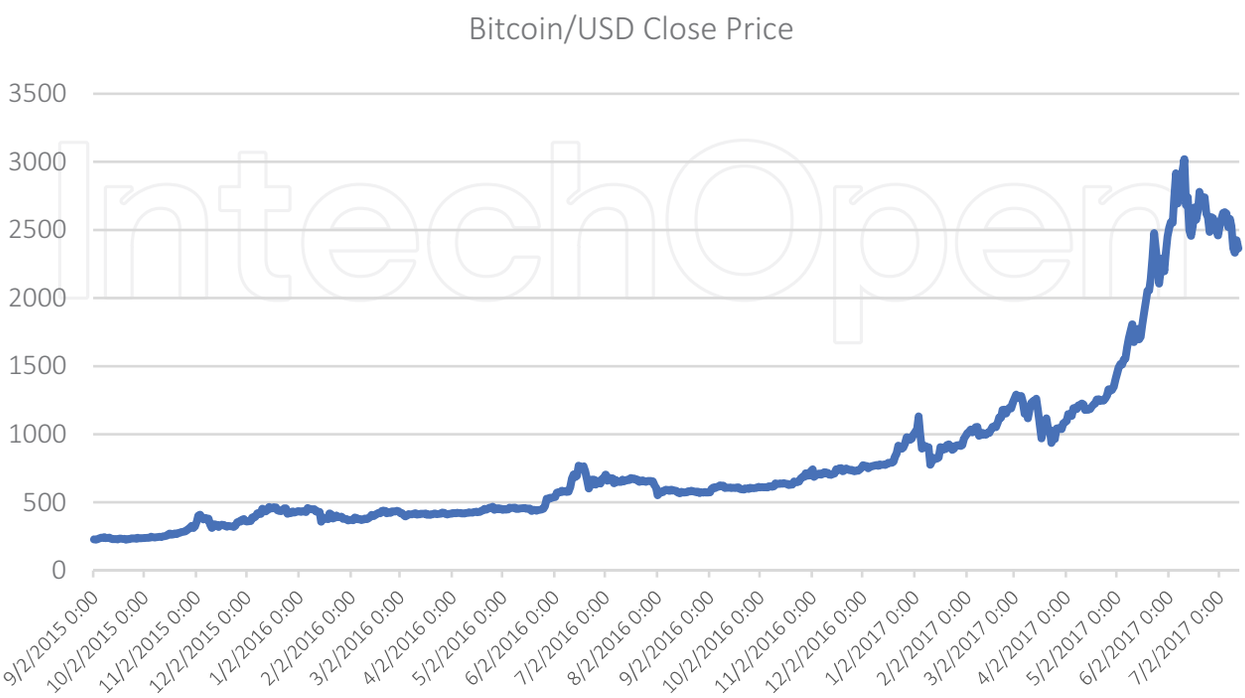

Figure 2. Bitcoin price in USD from September 2015 to July 2017.

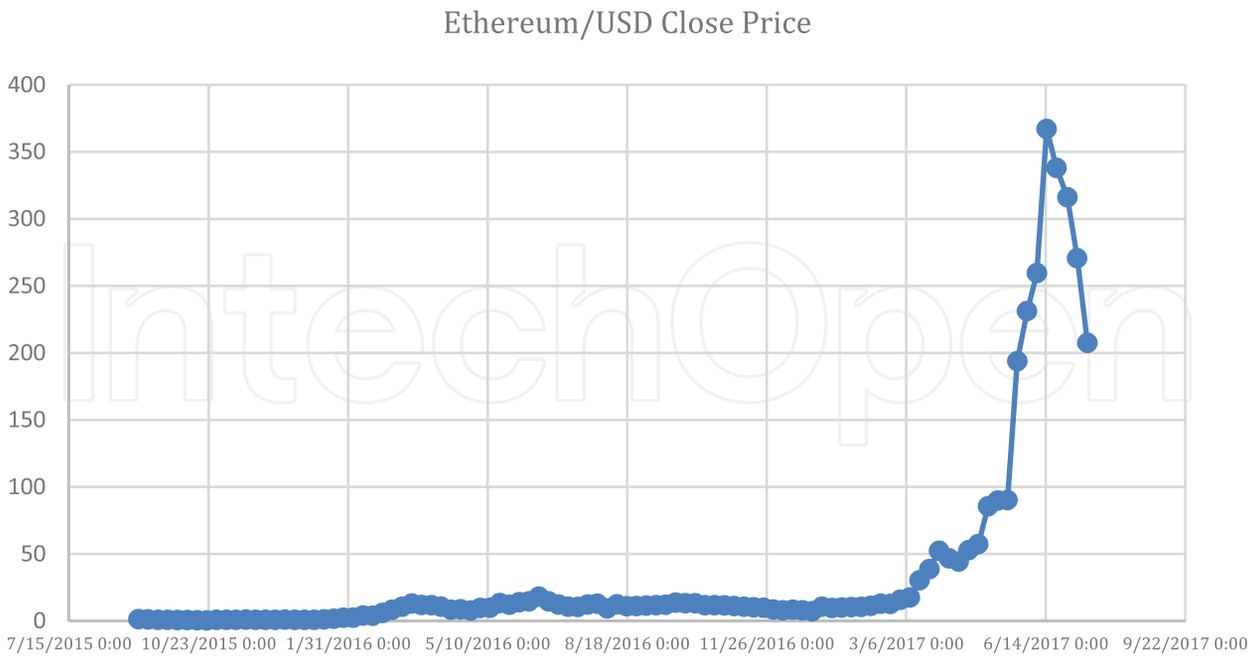

Figure 3. Ethereum price in USD from Sep 2015 to July 2017.

the price and the volume. In public stock exchanges, shares are publicly traded, transactions are recorded and the volumes are displayed. Hence, it becomes easy to calculate the trading volume for such stock exchanges. To better understand this trade volume, let us consider the following example:

EXAMPLE:

Suppose that Samsung only changes hands twice during the day. Let's assume that 20 million shares were bought at $10 a share; later 30 million shares were purchased at $10.5 a share.

The total trading volume = 20 +30 = 50 million shares

Dollar amount equals = (20X10) + (30X10.5) = $515 million

So, the total circulation of Samsung Shares is 515 million for that day.

3. Empirical analysis

There is a plethora of information about Bitcoin. The blockchain provides free information about every detail of the market on an hourly basis. To better understand the market size of Bitcoin, market capitalization [9] data are used. Further investigation is carried out to understand the price impact of Bitcoin as a currency against the US Dollar and the economic movement in terms of a commodity, and the following time series variables are analyzed. The sample is taken from Sep 2015 till July 2017 from coinmarketcap [10].

1. Total Bitcoins in circulation: market capitalization
2. Estimated output volume
3. Bitcoin price changes

3.1. Regression analysis

A regression analysis is used to explain the impact of the variables, market capitalization (CAP), output volume (VOL) and Bitcoin closing price (BTC), and then the relationship of the regression equation to the model is discussed. The best regression equation, based on the analysis of DW (Durbin-Watson), AIC (Akaike **i**nformation **c**riterion) and SC (Schwarz **c**riterion), is fitted (**Table 1**).

From the resultant equation, the t-statistics, r-squared and adjusted r-squared show a strong positive relation and suggest that the regression equation fits well as indicated in **Figure 4**.

3.2. The augmented Dickey-Fuller (ADF) unit-root test

ADF is used under the three conditions for every time series. The random process includes intercept (c) and trend (t), second includes intercept (c) but no trend (0) and third includes no intercept (0) and trend (t). It was observed that each variable under the Augmented Dickey-Fuller test statistic has a unit root at various lag lengths. This augments the data and the model (**Figure 5**).

3.3. Objectives of the gradient function

Table 2 and **Figure 4** allow us to observe the gradients of the objective function for Bitcoin and to help us find a unit root before applying the cointegrating techniques. The result indicates that all the variables, Bitcoin price, market capitalization and volume have a unit root in their levels and are stationary in their first-order differences (**Figure 6** and **Table 3**).

Variable	Coefficient	Std. error	t-Statistic	Prob.
VOL	5.00E−08	1.00E−08	4.980007	0.0000
CAP	5.90E−08	3.99E−10	147.9187	0.0000
C	39.11393	3.673930	10.64635	0.0000
R-squared	0.994337	Mean dependent var	825.9079	
Adjusted R-squared	0.994320	S.D. dependent var	628.2927	
S.E. of regression	47.35140	Akaike info criterion	10.55743	
Sum squared resid	1,533,634	Schwarz criterion	10.57722	
Log likelihood	−3623.476	Hannan-Quinn criter.	10.56508	
F-statistic	60046.28	Durbin-Watson stat	2.019589	
Prob(F-statistic)	0.000000			

Table 1. Regression results.

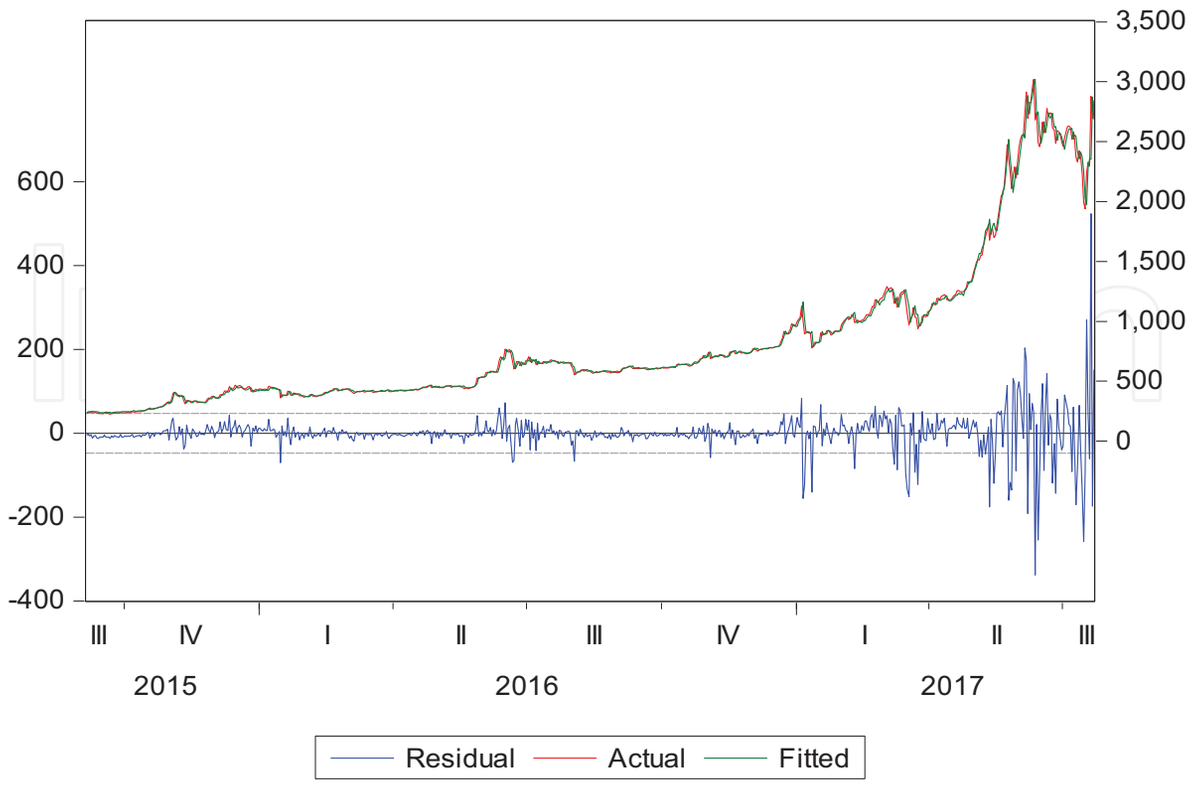

Figure 4. Residual, actual and fitted.

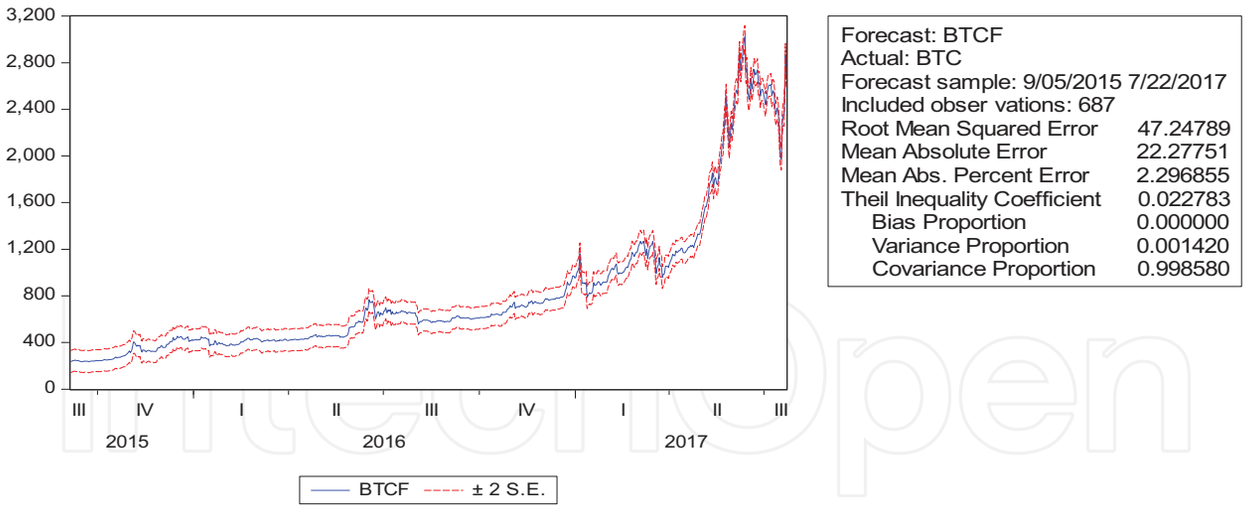

Figure 5. BTC estimated value, denoted as BTCF.

3.4. Var cointegration test statistic

The Johansen cointegration technique is used to check the behavior of the variables. The results obtained are presented in **Table 4**. The cointegration relationships are determined with lag intervals between 1 and 4 with 5% critical values. The unrestricted co-integration rank is applied.

http://dx.doi.org/10.5772/intechopen.71294

Null hypothesis: D(BTC) has a unit root			
Lag length: 0 (automatic-based on SIC, maxlag = 19)			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		−27.86005	0.0000
Test critical values:	1% level	−3.439668	
	5% level	−2.865542	
	10% level	−2.568958	
Null hypothesis: D(VOL) has a unit root			
Lag length: 4 (automatic-based on SIC, maxlag = 19)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		−17.96755	0.0000
Test critical values:	1% level	−3.439724	
	5% level	−2.865567	
	10% level	−2.568971	
Null hypothesis: D(CAP) has a unit root			
Lag length: 0 (automatic-based on SIC, maxlag = 19)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		−26.47374	0.0000
Test critical values:	1% level	−3.439668	
	5% level	−2.865542	
	10% level	−2.568958	

*MacKinnon (1996) one-sided *p*-values [11].

Table 2. The ADF test statistic.

3.5. Granger causality tests

The Granger causality test is used to analyze further the relationship between the three variables. Pairwise tests are carried out in Eviews, and results are shown in **Table 5**. When the lag is 2, the Granger-cause between the variables does not exist. Hence, this proves that the above cause-and-effect relationship is unidirectional and not bidirectional for BTC.

3.6. Impulse response function

To categorize the dynamic structure of Bitcoin, the Monte Carlo simulation is applied through the impulse response functions in the model. It shows how shocks to any one variable filter through the model can affect every other variable and eventually feed back to the original variable itself.

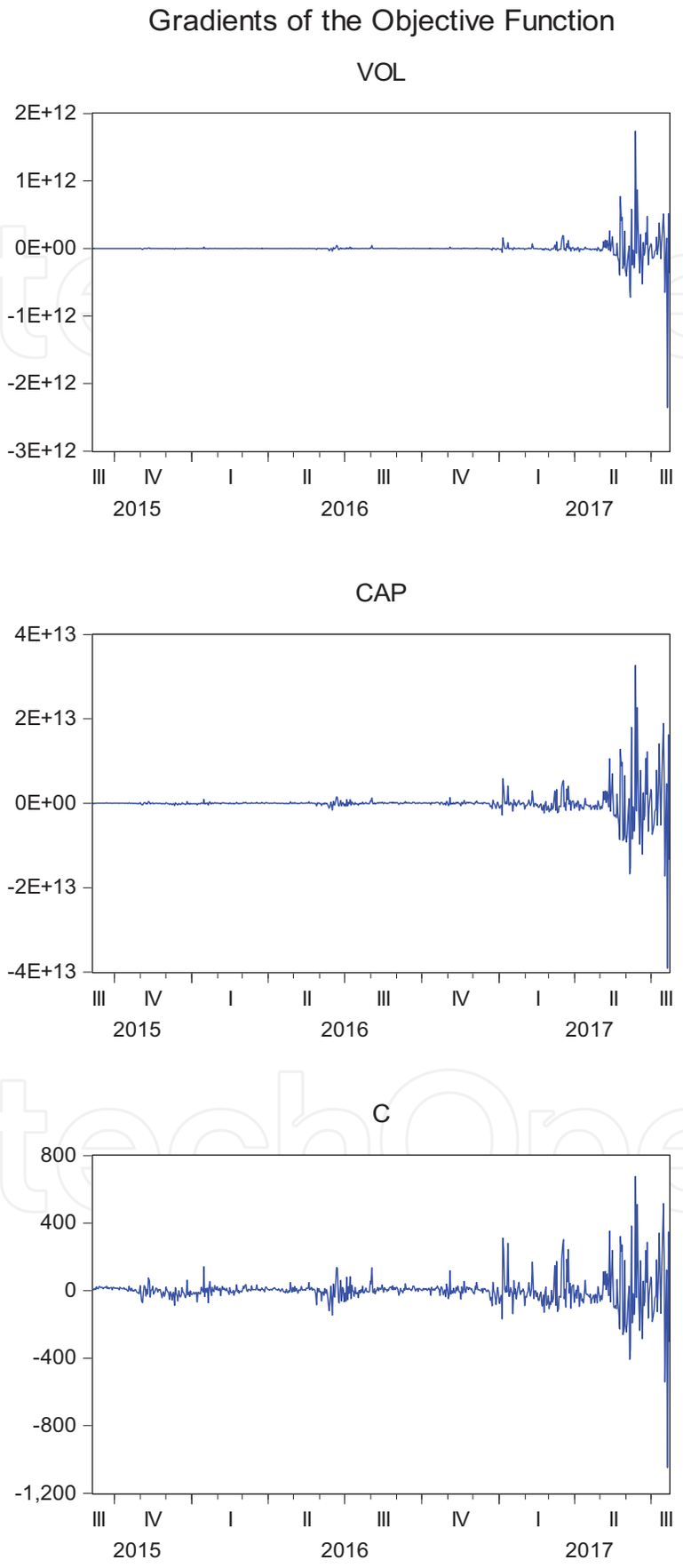

Figure 6. Gradients of the objective function.

Variable	Sum	Mean	Weighted grad.
VOL	0.063843	9.29E−05	2.35E−26
CAP	−1.869141	−0.002721	−3.00E−27
C	−8.16E−11	−1.19E−13	6.36E−17

Table 3. Gradients of the objective function.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical value**	**Prob.****
None*	0.058289	68.77080	29.79707	0.0000
At most 1*	0.037385	27.81187	15.49471	0.0004
At most 2	0.002675	1.826802	3.841466	0.1765
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical value**	**Prob.****
None*	0.058289	40.95893	21.13162	0.0000
At most 1*	0.037385	25.98507	14.26460	0.0005
At most 2	0.002675	1.826802	3.841466	0.1765

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level; Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level.

*Rejection of the hypothesis at the 0.05 level.

**MacKinnon-Haug-Michelis (1999) *p*-values [12].

Table 4. Johansen cointegration test.

Null hypothesis	Obs	F-statistic	Prob.
VOL does not Granger Cause BTC	685	3.49151	0.0310
BTC does not Granger Cause VOL		32.2346	4.E−14
CAP does not Granger Cause BTC	685	3.58576	0.0282
BTC does not Granger Cause CAP		10672.5	0.0000
CAP does not Granger Cause VOL	685	28.1865	2.E−12
VOL does not Granger Cause CAP		10.9612	2.E−05

Table 5. Pairwise Granger Causality Tests with lags 2.

Monte Carlo [13] simulation is best employed through possible random movements in the model. This perfectly fits the scenario of Bitcoin. There are two components to a stock's price movements: drift, which is a constant directional movement, and a random input, representing market volatility. By analyzing historical price data, the drift, standard deviation,

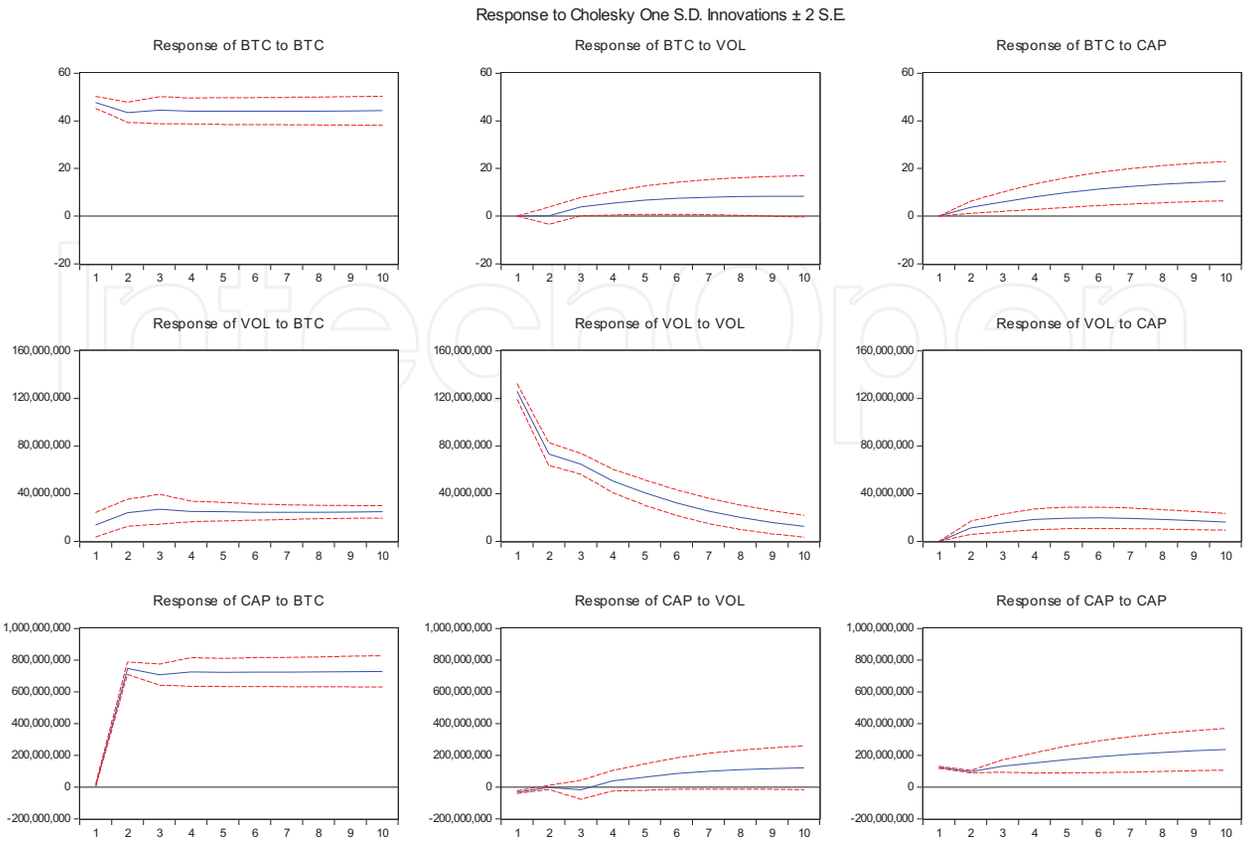

Figure 7. Impulse response functions—Monte Carlo simulation.

variance and average price movement for a security is determined. These are the building blocks of a Monte Carlo simulation. The horizontal spool in **Figure 7** delegates trace periods of the response function, and the vertical spool delegates responses of dependent variables to independent variables.

4. Bitcoin and the future economy

In an era where having a smart phone is highly more likely than having a Bank account, Bitcoin is here to stay. The architecture of money that we live in today brings the borrower and lender together through a financial intermediary, usually a Bank. One of the parties usually conforms to the rules and regulations put forth by the financial institution making it the most sought-after financial product the banks have to offer. People with limited education and a profile not matching to open a bank account can open a Bitcoin account in under 30 seconds.

Bitcoin is Gold 2.0 because Bitcoin is great as a store of value.

As of June 2017, the total value of all cryptocurrency in circulation is now [14] almost $100 bn.

This is almost double of what was at the beginning of this year. The value of the fiat currency issued by the Federal Reserve Bank of $1.4 trillion cannot be undermined, but an alternative is underway albeit faster than predicted. Cryptocurrencies are borderless, decentralized, and capable of replacing money in just about any transaction. Without any physical infrastructure, Bitcoin has paved its way into the world economy because of ease of use. The "no-strings" attached idea has appealed to the masses. It is positively one of the most innovative inventions ever since the Internet came. It is Internet money and a digital currency; to stop this, we would have to stop the Internet. This is the power of Bitcoin.

From pizza to Porsche, hotel bookings and even goat, [15] you can buy just about anything by using Bitcoin.

5. Blockchain, Bitcoin and the UAE

Bitcoin and blockchain technology are currently being used by different businesses and organizations. A peer-to-peer system, without the middlemen, where the buyer pays less and the seller receives more is a phenomenon the world is witnessing currently. Countries are passing policies for its free trade, while other countries like UAE and especially Dubai are adopting it as a part of their Smart Dubai 2020 initiative. Taking the possibilities to another level, the future of Bitcoin is evident from the establishment of a Global Block Chain Council under Dubai Government. It quotes: "As part of its efforts to adopt the latest technologies and innovation practices at the global level, Dubai Future Foundation has announced the establishment of the Global Blockchain Council to explore, discuss current and future applications, and organize transactions through the Blockchain platform. Blockchain records every transaction made by the digital currency Bitcoin" [16]. Similarly, a UAE start-up has come out with a gold-backed cryptocurrency called one-gram, giving users, an asset-backed model of digital currencies. With the GCC accounting for a substantial proportion of global remittances, foreign exchange houses are big business, and many say incorporating Bitcoin-enabling technology would be commercially advantageous, as it would help them to cut costs and provide better services to customers [17]. The volatility of Bitcoin is yet to be seen, as some analysts claim it to be a bubble, while others are cashing in on the cryptocurrency. The future where money may be limited to exchange of Bitcoins, the circulation of the Bitcoins remains to be seen once all 120 million Bitcoins are mined and circulated.

Author details

Asma Salman* and Muthanna G. Abdul Razzaq

*Address all correspondence to: asma.salman@aue.ae

American University in the Emirates (AUE), Dubai, United Arab Emirates (UAE)

References

[1] Satoshi Nakamoto. Bitcoin: A Peer-to-Peer Electronic Cash System. 2008. https://bitcoin.org/bitcoin.pdf

[2] Gulf News. UAE Central Bank clarifies virtual currency ban [Internet]. 1st Feb, 2017 [Updated: 1st Feb, 2017]. Available from: http://gulfnews.com/business/sectors/banking/uae-central-bank-clarifies-virtual-currency-ban-1.1971802 [Accessed: 24th July 2017]

[3] Blockchain Luxembourg. Bitcoin Stats [Internet]. 23rd July 2017 [Updated: 23rd July 2017]. Available from: https://blockchain.info/charts/total-bitcoins [Accessed: 23rd July 2017]

[4] Amro Zakaria Abdu. Newsweek Middle East Business Outlook: Will "Share Economy" be Disrupted by Blockchain Technology? [Internet]. 9th November 2016 [Updated: 9th November 2016]. Available from: http://newsweekme.com/business-outlook-will-share-economy-disrupted-blockchain-technology/ [Accessed: 24th July 2017]

[5] Mark Hewitt, The Digital Transformation People. What is Blockchain? [Internet]. November 10, 2016 [Updated: November 10, 2016]. Available from: http://www.thedigitaltransformationpeople.com/channels/enabling-technologies/what-is-blockchain [Accessed: July 24th, 2017]

[6] Coin Desk. Coin Desk Prices [Internet]. 24th July 2017 [Updated: 24th July 2017]. Available from: https://www.coindesk.com/price/ [Accessed: 24th July 2017]

[7] Don Tapscott. Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World [Internet]. April 2016 [Updated: July 2017]. Available from: http://dontapscott.com/ [Accessed: 24th July 2017]

[8] Blockgeeks. [Internet]. Feb 2017 [Updated: July 2017]. Available from: https://blockgeeks.com/guides/what-is-ethereum/ [Accessed: 24th July2017]

[9] Kristoufek L. What are the main drivers of the Bitcoin price? Evidence from wavelet coherence analysis. PLoS One. 2015;**10**(4):e0123923. PMC4398561. DOI: 10.1371/journal.pone.0123923

[10] CryptoCurrency Market Capitalizations. Historical Data [Internet]. Hourly [Updated: 24th July 2017]. Available from: https://coinmarketcap.com/currencies/bitcoin/historical-data/?start=20150905&end=20170722 [Accessed: 24th July 2017]

[11] MacKinnon JG. Numerical distribution functions for unit root and cointegration tests. Journal of Applied Econometrics. 1996;**11**(16). DOI: 10.1002/(SICI)1099-1255(199611)11:6<601::AID-JAE417>3.0.CO;2-T

[12] MacKinnon JG, Haug AA, Michelis L. Numerical distribution functions of likelihood ratio tests for cointegration. Journal of Applied Econometrics. 1999;**14**(5). DOI: 10.1002/(SICI)1099-1255(199909/10)14:5<563::AID-JAE530>3.0.CO;2-R

[13] Investopedia. Monte Carlo Simulation [Internet]. [Updated: July 2017]. Available from: http://www.investopedia.com/terms/m/montecarlosimulation.asp [Accessed: 24th July 2017]

[14] Financial Times. The Consequences of Allowing a Cryptocurrency Takeover, or Trying to Head One Off [Internet]. June 8, 2017 [Updated: June 8, 2017]. Available from: https://ftalphaville.ft.com/2017/06/07/2189849/guest-post-the-consequences-of-allowing-a-cryptocurrency-takeover-or-trying-to-head-one-off/ [Accessed: Sep 22, 2017]

[15] Business Insider. 10 Real Things You Can Buy with Bitcoin [Internet]. April 10, 2013 [Updated: April 10, 2013]. Available from: http://www.businessinsider.com/what-can-i-buy-with-bitcoins-2013-4#want-to-start-at-the-beginning-11 [Accessed: Sep 22, 2017]

[16] Dubai Future Foundation. Global Blockchain Council [Internet]. 2016 [Updated: 2017]. Available from: http://www.dubaifuture.gov.ae/our-initiatives/global-blockchain-council/ [Accessed: Sep 22, 2017]

[17] Arabian Business. Banking on Bitcoin: Cryptocurrency's Growth in the Gulf [Internet]. Aug 31, 2017 [Updated: Aug 31, 2017]. Available from: http://www.arabianbusiness.com/interviews/banking-finance/377722-banking-on-bitcoin-cryptocurrencys-growth-in-the-gulf [Accessed: Sep 22, 2017]

IntechOpen