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A eficiência relativa das casas de câmbio de Bitcoins (The relative efficiency of Bitcoin exchanges)

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OUTLINE

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2. Concepts and mechanics of Bitcoin

- Bitcoin was firstly presented in a self-published paper by the mysterious Satoshi Nakamoto on October 31, 2008 (the first 50 bitcoins issued were mined by its creator (the Genesis Block), and in the early days, Nakamoto is estimated to have mined 1 million bitcoins before disappearing from any involvement in bitcoin.
- First payment: two take-away pizzas (valued at about $25) for 10 000BTC. This assigned the first concrete valuation of BTC ($0.0025 per BTC, current conversion rate 10 442,34)
- Bitcoin reached a maximum of $19 783.21 on Dec. 2017.
- The Bitcoin has been subjected to a deflation phenomenon as the Bitcoin usage increases more than the generation of new Bitcoins (most of Bitcoins are dormant):
  - In 2015, 42 400 dormant bitcoin addresses with a balance of 25BTC or more. Total = 3 380 582BTC.
  - One key address with 79 957BTC ($835 million)???

1. The cryptocurrencies world (Some figures!)

- Existing Cryptocurrencies: 1523
- Existing Markets (online exchanges): 8796

The most importante 5 cryptocurrencies (cap> 10 000M USD)	Market Capitalization (USD)	24h Volume (USD)	Circulating Supply (Crypto)	Max Supply (Crypto)
Bitcoin	179 923	7 196	16.89	21
Ethereum	85 632	2 067	97.88	100
Ripple	37 165	336	39 094	99 993
Bitcoin Cash	21 209	418	16.99	21
Litcoin	12 025	921	55.40	84

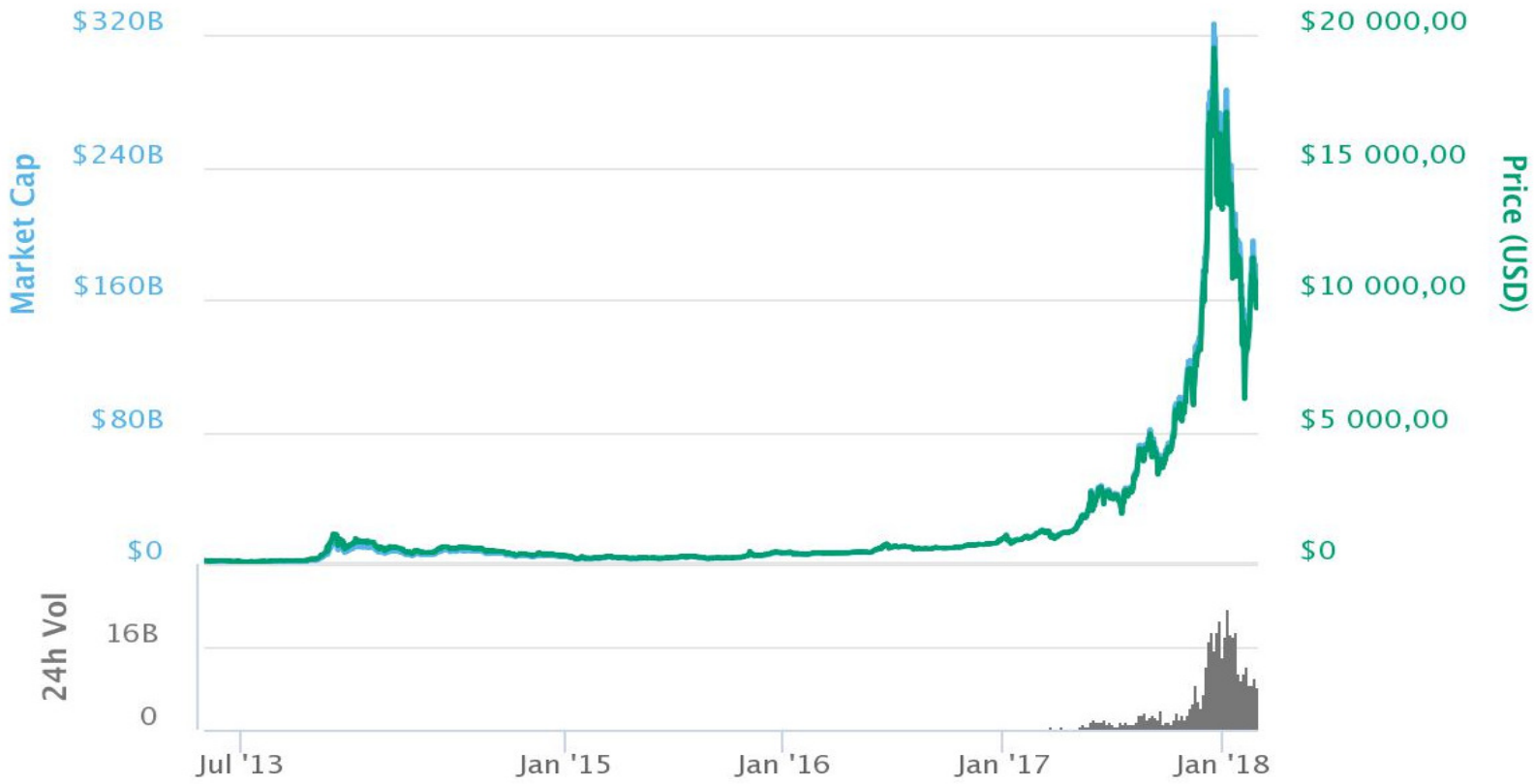
Unit: millions.
Source: https://coinmarketcap.com
Obtained at: 17:00 p.m. 27-02-2018

- Inicial Coin Offering crowdfunding for startup companies

- Bitcoin Futures (Chicago Mercantil Exchange and Chicago Board Options Exchange)

1. The cryptocurrencies world (Some figures!)

Bitcoin



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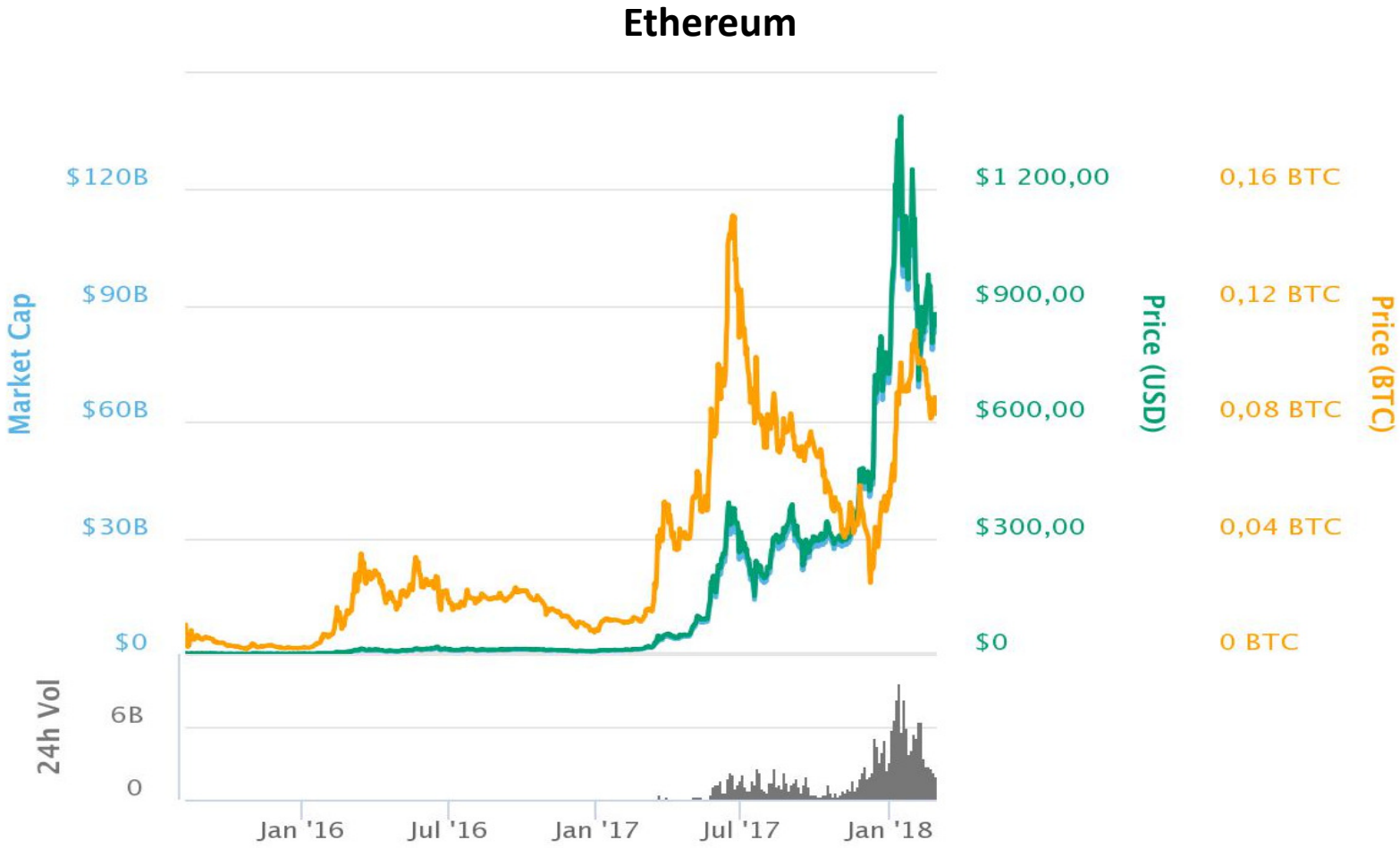

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1. The cryptocurrencies world (Some figures!)

Ripple

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1. The cryptocurrencies world (Some figures!)

Bitcoin Cash

Unit: millions.

Source: https://coinmarketcap.com

Obtained at: 17:00 p.m. 27-02-2018

1. The cryptocurrencies world (Some figures!)

Litcoin

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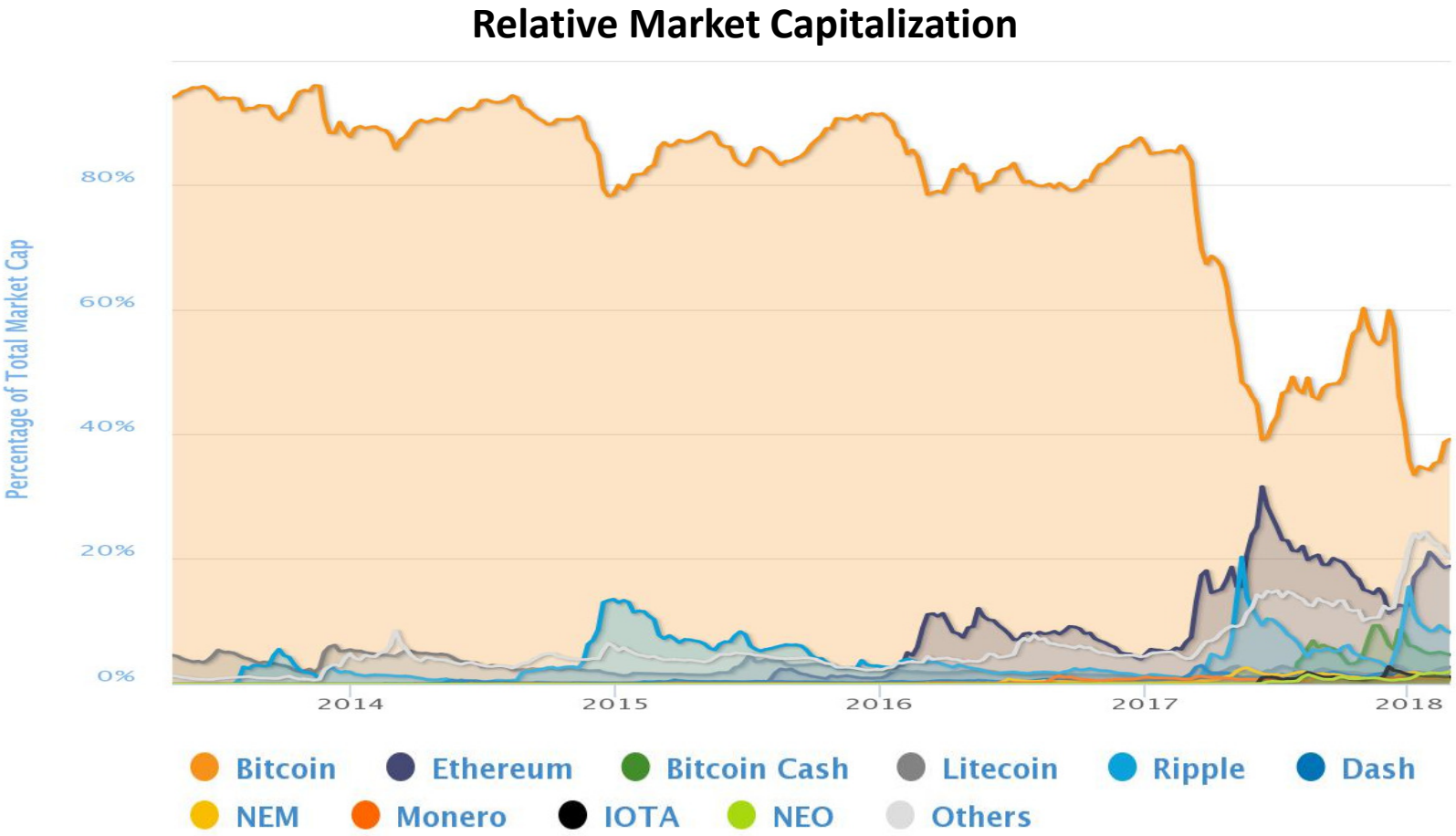

Unit: millions.
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❑ The basic concepts

- Bitcoin is a open source peer-to-peer (P2P) protocol, used to produce and manage a virtual decentralised payment system, mainly designed for supporting online transactions.
  - Completely virtual
  - Open source (anyone can trade in bitcoins)
  - The concept of virtual or digital currency precedes the Bitcoin. The Bitcoin success is due to solving the double-spending problem.
  - Peer-to-peer (P2P) payment system (there is no intermediation), the network manages balances and electronic transactions on its own
  - Completely decentralised (it is not backed up by any central monetary authority)

❑ The mechanics

- For a trade to happen, a **private Bitcoin key** of one user has to match the information of a **public Bitcoin key** of another user
- When a Bitcoin is sent from one address to another, the trande information is **collected by the network**
- Trades are gathered into logical entities known as **blocks** which are added to the public available Bitcoin database, the **Blockchain**
- Using **cryptography,** miners resolve a computational problem and create **mathematical proofs** to **secure the block** and **safeguard the trades in the block**
- Miners are **rewarded** by a fixed amount of new bitcoins plus the trading costs payed only by the seller
- These **proofs are verified and validated by all miners** who admit the blocks as part of the Blockchain (since the genesis block)
  - The P2P protocol ensures that a single ordering of transactions becomes accepted by all
  - Ensure that double spending or any kind of fraud or hacking is prevented

2. Concepts and mechanics of Bitcoin

- **Merits:**
  - Low transfer costs (0,0001BTC)
  - No cross-border restrictions
  - Absence of intermediary costs (Exchanges charge 0.25% to 0.5%)
  - Anonymity

- **Disadvantages**
  - Bitcoins are kept in digital wallets, which are prone to hacker attacks, and there is no insurance services as in the case of fiat money issued by banks
  - There is no central clearing nor third part guaranteeing activity
  - The brief history of Bitcoin is replete of malpractices, money laundry and financing criminal activities,
  - Suspicion by monetary authorities:
    - No monetary policy can be conducted, for example, to promote economic growth.
    - Trading bitcoins as a tax evasion strategy.
    - In the presence of a speculative bubble or even a Ponzi scheme?

What are the most efficient Bitcoin exchanges?

Sebastião, H.; Duarte, A. P. & Guerreiro, G. (2017) Where is the information on USD/Bitcoins hourly price movements?, *Notas Económicas*, 45, 7-25. DOI: https://doi.org/10.14195/2183-203X_45_1.

3.1 Data and preliminary statistics

- **Sample:**
  - Data collected from www.bitcoincharts.com. The site compiles all transaction data on several exchanges that trade bitcoins against fiat currencies (e.g. USD and CNY).
  - Only USD/BTC market (the main Chinese exchanges dealing with Yuan, tend to exaggerate their trading volume in order to attract more traders).
  - The sample period (01/03/2014 until 30/11/2016) was defined by two particular events:
    - On February 25, 2014, Mt.Gox (market with a share of 74.83%) closed permanently for business.
    - On December 8, 2017, the site ended publishing Bitfinex data, due to a change in their API (hack attack – 120000 BTCs stolen)
  - Sampling interval of one hour: price indexes weighted by trading volume and trading volume in BTC.
  - 14 exchanges (total of 52 exchanges) active at least one year during the sample period (these exchanges account for 74.34% of the total Bitcoins traded against USD during the sample period).

3.1 Data and preliminary statistics

Exchanges	Headquarters	Data availability	Volume	Average time lag	Volume per trade
Bitfinex	Hong Kong	Full sample	22.148 (30.46%)	10s	2.548
Bitstamp	Luxembourg	Full sample	11.099 (15.27%)	12s	1.532
BTC-e	Bulgaria	Full sample	7.3712 (10.14%)	5s	0.424
Coinbase	San Francisco USA	Since 01/12/2014	5.0439 (6.94%)	7s	0.406
ItBit	New York USA	Full sample	3.6011 (4.95%)	1m59s	4.930
LakeBTC	Shanghai China	Until 19/06/2015	2.1103 (2.90%)	24s	0.583
LocalBitcoins	Finland	Since 11/03/2013	1.6223 (2.23%)	52s	0.971
Kraken	San Francisco USA	Full sample	0.4260 (0.59%)	3m11s	0.936
HitBTC	UK	Full sample	0.3526 (0.48%)	1m36s	0.389
Onecoin	Bulgaria	09/03/2014 to 04/04/2015	0.2318 (0.31%)	1m54s	0.029
Rock	Malta	Full sample	0.0206 (0.03%)	23m34s	0.335
CampBX	Atlanta USA	Until 19/10/2016	0.0150 (0.02%)	36m49s	0.267
BitKonan	Croatia	Full sample	0.0096 (0.01%)	58m6s	0.385
Bitbay	Poland	Since 16/05/2014	0.0091 (0.01%)	19m12s	0.121

3.1 Data and preliminary statistics

- **Obtain a** fairly **continuous time series without many gaps**
  - **Separation of Bitfinex**, **Bitstamp**, **BTC-e** and **ItBit** from all the other exchanges
  - Creation of a **pool of exchanges**, denominate by "**Others**"
- Assumption: the **USD/BTC market** was totally **composed by**
  - **Bitfinex** with a **market share**, given by the **relative trading volume** of **40.97%**,
  - **Bitstamp**, **20.53%**,
  - **BTC-e**, **13.64%**,
  - **ItBit**, **6.66%**, and
  - **Others**, **18.20%.**

3.1 Data and preliminary statistics

	Bitfinex	Bitstamp	BTC-e	ItBit	Others
No. of zeros	203	108	653	3580	0
	(0.8%)	(0.4%)	(2.7%)	(14.8%)	
Mean (10^{-5})	1.2531	1.3131	1.3203	1.1261	1.0927
Minimum	-0.1656	-0.1390	-0.1498	-0.5056	-0.4771
Percentile 5	-0.0086	-0.0087	-0.0080	-0.0082	-0.0257
Median	0.0000	0.0001	0.0000	0.0000	0.0003
Percentile 95	0.0085	0.0083	0.0080	0.0079	0.0248
Maximum	0.1053	0.1178	0.1016	0.5428	0.4967
Std. dev.	0.0063	0.0062	0.0062	0.0081	0.0179
Skewness	-1.0749	-0.6081	-0.9125	2.1412	-0.0693
Kurtosis	43.590	34.074	48.419	151.76	68.504
J-B (10^{6})	1.6620 ***	0.9728 ***	2.0786 ***	2307.6 ***	4.3163 ***
Autocorr(1)	0.1282 ***	0.1416 ***	0.1139 ***	0.0089	-0.3578 ***
Autocorr(2)	-0.0879 ***	-0.0772 ***	-0.0589 ***	-0.2176 ***	-0.0187 ***
Autocorr(3)	-0.0466 ***	-0.0488 ***	-0.0365 ***	-0.0154 **	0.0092
BIC	3	3	3	5	52

3.2 Methodology

Each pair of Bitcoin time series of returns, $\{r_{it}, r_{jt},\}$, sampled at some frequency, say hourly, can be expressed as a bivariate autoregressive process of an arbitrary order p:

$$\begin{bmatrix} r_{it} \\ r_{jt} \end{bmatrix} = \begin{bmatrix} A(L) & B(L) \\ C(L) & D(L) \end{bmatrix} \begin{bmatrix} r_{it} \\ r_{jt} \end{bmatrix} + \begin{bmatrix} \varepsilon_{it} \\ \varepsilon_{jt} \end{bmatrix}.$$

$A(L)$, $B(L)$, $C(L)$ and $D(L)$ are polynomials in the lag operator, L, and the innovations are Gaussian (i.e. ε_{kt} are independently and identically $N(0, \sigma_k^2)$, *for* $k = i, j$)

The innovations covariance matrix is

$$\boldsymbol{\Omega} = cov \begin{bmatrix} \varepsilon_{it} \\ \varepsilon_{jt} \end{bmatrix} = \begin{bmatrix} \sigma_i^2 & \sigma_{ij} \\ \sigma_{ji} & \sigma_j^2 \end{bmatrix}.$$

3.2 Methodology

For a bivariate process, there are two lagged feedback

hypotheses: $H_{i\not\Rightarrow j}: C(L) = \mathbf{0}$ and $H_{j\not\Rightarrow i}: B(L) = \mathbf{0}$. Under these hypotheses, the

VAR simplifies to:

$$\begin{bmatrix} r_{it} \\ r_{jt} \end{bmatrix} = \begin{bmatrix} A(L) & \mathbf{0} \\ \mathbf{0} & D(L) \end{bmatrix} \begin{bmatrix} r_{it} \\ r_{jt} \end{bmatrix} + \begin{bmatrix} \xi_{it} \\ \xi_{jt} \end{bmatrix}.$$

Additionally, if there is no contemporaneous linear relationship between the series, $H_{i\not\Leftrightarrow j}$, then $cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$.

The hypothesis of no linear link between the two variables is given by the conjunction of the previous hypotheses: $H_{i\not\sim j} = H_{i\not\Rightarrow j} \cap H_{i\not\Leftrightarrow j} \cap H_{j\not\Rightarrow i}$.

3.2 Methodology

The measures proposed by Geweke (1982) allow testing these hypotheses:

Measure of lagged feedback from *i* to *j*:

$$F_{i\to j} = ln\left(\sigma^2_{\xi_j}/\sigma^2_{\varepsilon_j}\right).$$

Measure of lagged feedback from *j* to *i*:

$$F_{j\to i} = ln\left(\sigma^2_{\xi_i}/\sigma^2_{\varepsilon_i}\right).$$

Measure of contemporaneous feedback between *i* and *j*:

$$F_{i\leftrightarrow j} = ln\left(\sigma^2_{\varepsilon_i}\sigma^2_{\varepsilon_j}/|\boldsymbol{\Omega}|\right).$$

Measure of total feedback between *i* and *j*:

$$F_{i.j} = ln\left(\sigma^2_{\xi_i}\sigma^2_{\xi_j}/|\boldsymbol{\Omega}|\right).$$

$|\boldsymbol{\Omega}|$ is the determinant of the innovations covariance matrix in the unrestricted model. Under the null hypothesis, these measures, multiplied by $Nobs.$, are asymptotically independent and follow chi-squared distributions with p, p, 1 and $2p+1$ degrees of freedom, respectively.

3.2 Methodology

The Geweke feedback measures have several advantages over other methodologies, such as the Wald F-test:

(i) Under the alternative hypothesis these statistics represent cardinal measures of the extent of linear dependence in the two series.

(ii) These measures are additive: $\hat{F}_{i.j} = \hat{F}_{i\to j} + \hat{F}_{i\leftrightarrow j} + \hat{F}_{j\to i}$.

(iii) Comparison between the feedback within two pairs of variables is straightforward as long as the measures are estimated using the same number of observations.

(iv) These metrics are unaffected by pre-filtering the series by any invertible lag operator.

3.3 Results

Exch. (i)	Exch. (j)	Average Share	$F_{i\to j}$	$F_{j\leftrightarrow i}$	$F_{j\to i}$	$F_{j.i}$
Bitfinex	Bitstamp	30.75%	0.0495 (3.41%)	1.3948 (96.11%)	0.0070 (0.47%)	1.4512
Bitfinex	BTC-e	27.31%	0,059 (6.24%)	0.8783 (92.82%)	0.0089 (0.94%)	0.9463
Bitfinex	ItBit	23.82%	0.1361 (23.13%)	0.4485 (76.21%)	0.0039 (0.67%)	0.5886
Bitstamp	BTC-e	17.09%	0.0412 (4.35%)	0.8838 (93.33%)	0.0220 (2.32%)	0.9469
Bitstamp	ItBit	13.60%	0.1211 (19.81%)	0.4830 (79.02%)	0.0071 (1.17%)	0.6112
BTC-e	ItBit	10.15%	0.0888 (19.90%)	0.3447 (77.24%)	0.0128 (2.87%)	0.4463
Bitfinex	Others	5.38%	0.1615 (64.70%)	0.0864 (34.61%)	0.0017 ([a]) (0.69%)	0.2497
Bitstamp	Others	3.52%	0.1653 (62.51%)	0.0974 (36.82%)	0.0018 ([a]) (0.67%)	0.2645
BTC-e	Others	2.89%	0.1300 (60.49%)	0.0811 (37.74%)	0.0038 (1.77%)	0.2149
ItBit	Others	2.26%	0.1033 (52.78%)	0.0758 (38.70%)	0.0167 (8.52%)	0.1958

3.3 Results

Exchange (i)	$F_{i \to M}$	$F_{i \leftrightarrow M}$	$F_{M \to i}$	$F_{i.M}$
Panel A: Including Others				
Bitfinex	0.2031 (38.55%)	0.3219 (61.08%)	0.0020 ([a]) (0.40%)	0.5270
Bitstamp	0.1666 (25.53%)	0.4779 (73.21%)	0.0082 (1.26%)	0.6527
BTC-e	0.1122 (22.18%)	0.3786 (74.83%)	0.0151 (2.99%)	0.5060
ItBit	0.0565 (13.27%)	0.2953 (69.40%)	0.0737 (17.33%)	0.4256
Others	0.0048 (1.95%)	0.0849 (34.73%)	0.1549 (63.32%)	0.24454
Panel B: Excluding Others				
Bitfinex	0.1702 (18.29%)	0.7542 (81.06%)	0.0060 (0.65%)	0.9304
Bitstamp	0.1020 (10.10%)	0.8824 (87.37%)	0.0255 (2.53%)	1.0099
BTC-e	0.0401 (4.72%)	0.7701 (90.50%)	0.0407 (4.79%)	0.8510
ItBit	0.0086 (1.47%)	0.4465 (76.31%)	0.1300 (22.21%)	0.5852

3.4 Conclusions

- ✓ **Most of the information is transmitted between exchanges within an hour, at least for the main four exchanges (Bitfinex, Bitstamp, BTC-e and ItBit).**
- ✓ **Lagged feedback runs mainly from the major exchange to the other exchanges, being its relative importance positively related to the difference in trading volume.**
- ✓ **The total feedback is highly correlated with the average market share, implying that the interrelationship between exchanges increases with their relative volume.**
- ✓ **The results suggest that Bitfinex is the dominant market in terms of the transmission of short run price information.**
- ✓ **The basket Others mostly reacts to price changes with a delay of at least one hour and therefore the minor exchanges may be seen as pure "satellite exchanges".**

4. Concluding remarks

- These results are only valid for the sample period.
- Bitcoin and other cryptocurrencies are not currencies yet.
  - It's a payment system (medium of payment)
  - Its not a unit of account, its not a way to store value, its not a medium of exchange.
- The Blockchain technology is a revolutionary concept.
- And when the maximum supply amount is reached (2040)?
  - Electricity costs
  - Rewarding mining: transaction costs
  - Deflationary process
- The competition cryptocurrencies and market value.

5. Online information sources

https://en.bitcoin.it/wiki/Main_Page

https://bitcoinity.org/

https://coinmarketcap.com

https://www.geekwrapped.com/cryptocurrency

https://www.coindesk.com/

https://bitcoincharts.com/

https://bitcoinmagazine.com/

https://cointelegraph.com/

https://news.bitcoin.com/