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Network Value To Transaction Volume (NVT) Analysis

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Introduction

Led by Bitcoin, in the last 3 years, the cryptocurrency markets have experienced unprecedented growth, both in valuation and issuance. Naturally, as an increasing number of retail and institutional investors asses this burgeoning asset class the search for acceptable valuation methodologies has intensified. We attempt here to expand upon one promising ratio-based tool, Network Value to Transactions (NVT). NVT was first presented by crypto data research analyst, Willy Woo, in his analysis of NVT on Bitcoin. We expand on his research in the areas of accurately estimating on-chain transaction volume to apply the NVT model to other Unspent Transaction Output cryptocurrencies such as Litecoin.

NVT Background

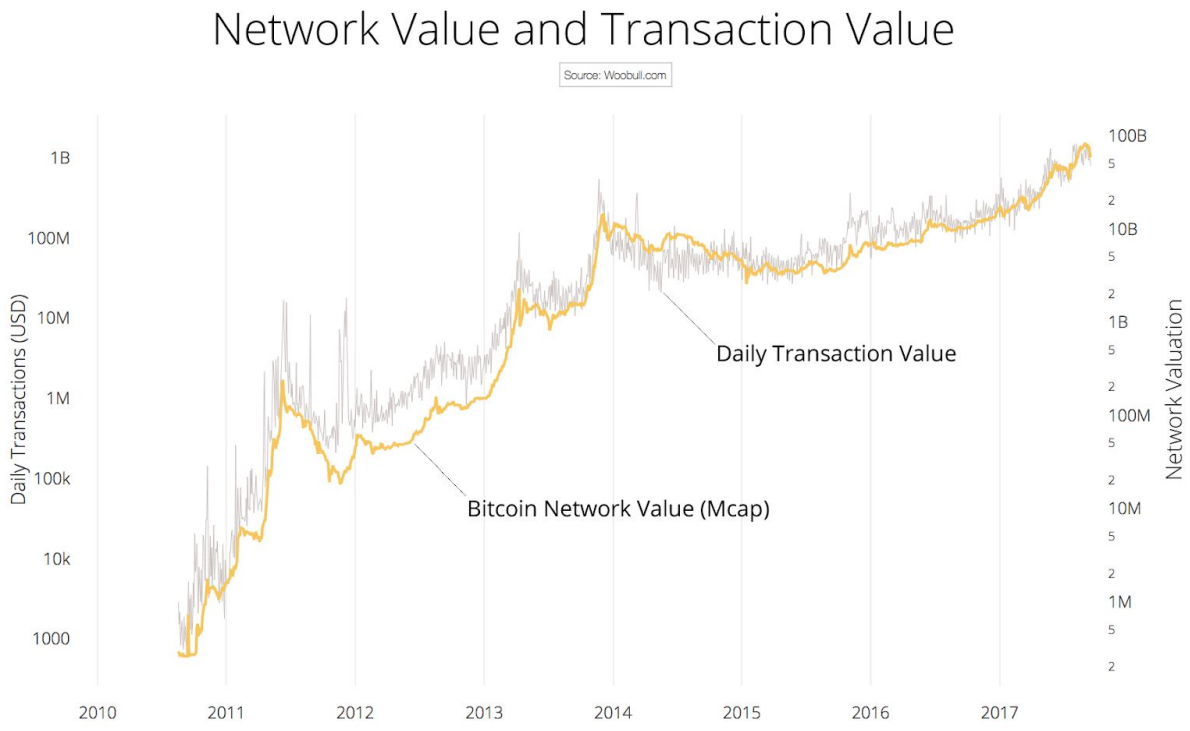
NVT is analogous to the commonly used Price / Earnings (P/E) or Enterprise Value / EBITDA (EV/EBITDA) ratios that are widely relied on in fundamental analysis of public equity investments. Just as stock prices can be influenced by any number of factors, so too can crypstoasset prices. Absent accepted metrics to tie a price movement to an underlying asset's operations these price fluctuations are left meaningless. Thus, like P/E and EV/EBITDA, NVT represents a potential tool to inform whether a specific cryptoasset's price is undervalued or overvalued relative to its own historical trading ranges of NVT and relative to other comparable cryptoassets.

NVT does this by quantifying the Network Value of a cryptoasset (numerator) at any point

in time in relation to the value of transaction activity occurring on its underlying blockchain (denominator).[1] Much like the stock market, Network Value is defined as market capitalization $price\ of\ cryptocurrency * coins\ in\ circulation$. However, unlike public equity investments, cryptoassets do not have "earnings" and so NVT uses the value of transactions that have been registered on the cryptoasset's blockchain as a measure of the underlying operational performance of the blockchain. In many ways, the denominator of both ratios is an assessment of the underlying asset's value.

Using Bitcoin as an example, Chris Burniske, who worked with Willy Woo to create this methodology, has described the transaction value parameter as "the underlying utility of Bitcoin, which is its ability to move money. That's bitcoin's core utility, same as a company's core utility is earnings."

On Woo's website, we see that the value transmitted on the Bitcoin blockchain closely mirrors price in the graph below:



Per the same logic as with P/E multiples, a low NVT relative to historical or comparable

assets implies that a specific coin may be undervalued and worth investment. Similarly, a high relative NVT multiple implies the market maybe overvaluing a coin at a specific point in time. Of course, investor perception around a stock or cryptoasset's future growth prospects must be taken into account in this calculation. When looking at this same graph, Woo notes "We can see in the early years of the Bitcoin network, growth was very steep. This resulted in the markets valuing the network high in comparison to the actual transaction value flowing through the network. In other words, we're seeing a network growing explosively which then demands a premium valuation based on future potential. This is very similar to what we see in PE ratios in the high growth stages of young companies."[2]

NVT Analysis Challenges and Current Limitations

In order to accurately assess the merits of using NVT as a valuation method on UTXO based coins we needed to have accurate measures for all the variables involved in the formula.

$$NVT = 28MA(\frac{Network\ Value}{Transaction\ Volume})$$

*28 day moving average uses 14 days backwards and 14 days forward average

For more established UTXO coins, such as Bitcoin, obtaining accurate daily network value is relatively easy. There are many websites and platforms like CoinMarketCap which have historical data on the market cap (network value) of coins and update the market cap frequently. It is also trivial to calculate the daily network value by hand. By taking the amount of tokens in circulation and multiplying it by the average price of bitcoin across exchanges, one can arrive at the daily nework value.

On the other hand, having an accurate value for daily transaction volume that represents economic activity (money changing hands) is difficult to obtain because there isn't a notion of people in most blockchain, just addresses. Since one person or entity can control multiple addresses, it is not fair to assume that a transaction sending money from one address to a different address represents real, independent economic activity. In

addition, exchange activity and people mixing their coins with other people's coins over multiple transactions further complicates estimating on chain transaction volume. For example, CoinMetrics asserts that most estimates of NVT for Blockchain “use blockchain.info’s estimates of USD transaction value on-chain” and that “Blockchain.info has an estimate of USD volume transmitted on chain that’s 5-6 times lower than ours, resulting in a higher NVT.”[3] As such, CoinMetrics uses an alternative NVT methodology to avoid double counting of certain transactions on the underlying Bitcoin blockchain. This issue is compounded in analyzing less well studied coins than Bitcoin given difficulty accessing data to determine true “On-Chain Transaction Volume” and thus limiting relative use of reliable NVT values.

Furthermore, differences in the use cases for the many cryptoassets available today diminish NVT’s application across markets. CoinMetrics suggests On-Chain Volume “is most relevant for a cryptocurrency adopted as a Means of Exchange (MoE)” and that “If Bitcoin were to become a pure Store of Value (SoV) asset, with relatively little turnover and little economic activity, on-chain volume would become less relevant.” This does not preclude the ability for ratio based analysis using other inputs to be implemented in valuing SoV coins, but for the purposes of our research have focused our research on Litecoin, another asset being used currently as a MoE.

BlockSci Blockchain Analytics Tool

In order to address some of the challenges and limitations of NVT we used the blockchain analytics tool BlockSci developed by Professor Arvind and his colleagues at Princeton University. BlockSci is an open-source software platform for blockchain analysis and has been used at Princeton as a research tool. It is available for public use at github.com/citp/BlockSci and we have employed BlockSci in our analysis of NVT. BlockSci is not limited to analyzing Bitcoin: it has the capability to support Bitcoin, Litecoin, Namecoin, Zcash and other Unspent Transaction Output (UTXO) based coins. Unfortunately smart contract platforms like Ethereum, which are account based coins, remain outside of its scope at the moment.

BlockSci uses an in-memory and an analytical instead of transactional database to make blockchains research much faster than other existing tools. Per the BlockSci white paper,

“BlockSci is 15x–600x faster than existing tools, comes bundled with analytic modules such as address clustering, exposes different blockchains through a common interface, imports exchange rate data and “mempool” data, and gives the programmer a choice of interfaces: a Jupyter notebook for intuitive exploration and C++ for performance-critical tasks.”

The platform enables analysis that can not be performed solely with raw blockchain data. It leverages both C++ and Python coding to facilitate ease of use. BlockSci can identify transactions types and identify change outputs using heristies, amongst several other features.

Estimation On-Chain Transaction Volume

Currently, Blockchain.info is the most widely used estimate of transaction volume of bitcoin for the purpose of valuation. Unfortunately, the underlying methodology is not available to the public, so when attempting to apply NVT to other UTXO coins such as Litecoin, we are left with an inaccurate estimate of daily transaction volume. Thus, in order to approximate a true transaction volume so as to extrapolate the same NVT methodology to other UTXO coins, we needed to come up with a methodology for estimating on-chain transaction volume.

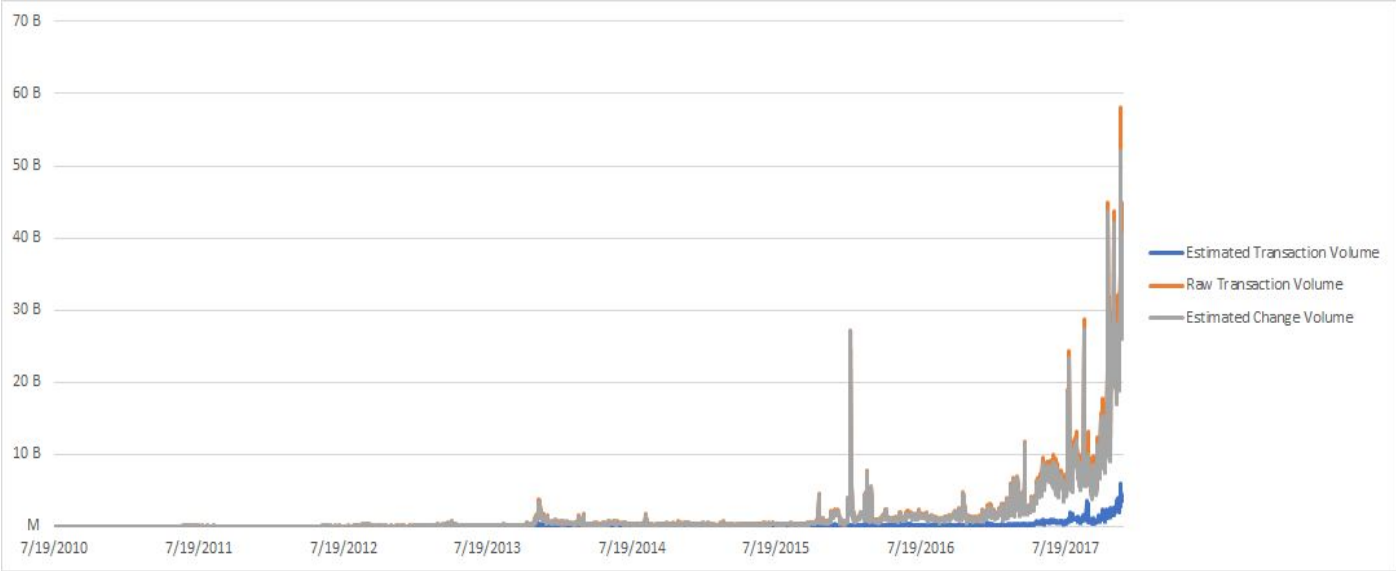
1. **Address Reuse Heuristic:** To minimize self-churn, we eliminated output with addresses linked to one of the input addresses. This can be thought of in the same way a cash transaction to purchase coffee results in change. If person A gives a cashier $20 for something that costs $19.50, Person A will receive .50 cents in a secondary transaction. Obviously, the value of the real economic activity of the purchase is $19.50 not the $20 person A handed the cashier. However, using Bitcoin, these two transactions are logged independently. Most wallet services abstract these transaction, thus obscuring what actually has occurred on chain and the $20 in total value transacted. Our solution, is to eliminating output with addresses linked to an input addresses so as to we eliminate some degree of self-churn and change addresses.

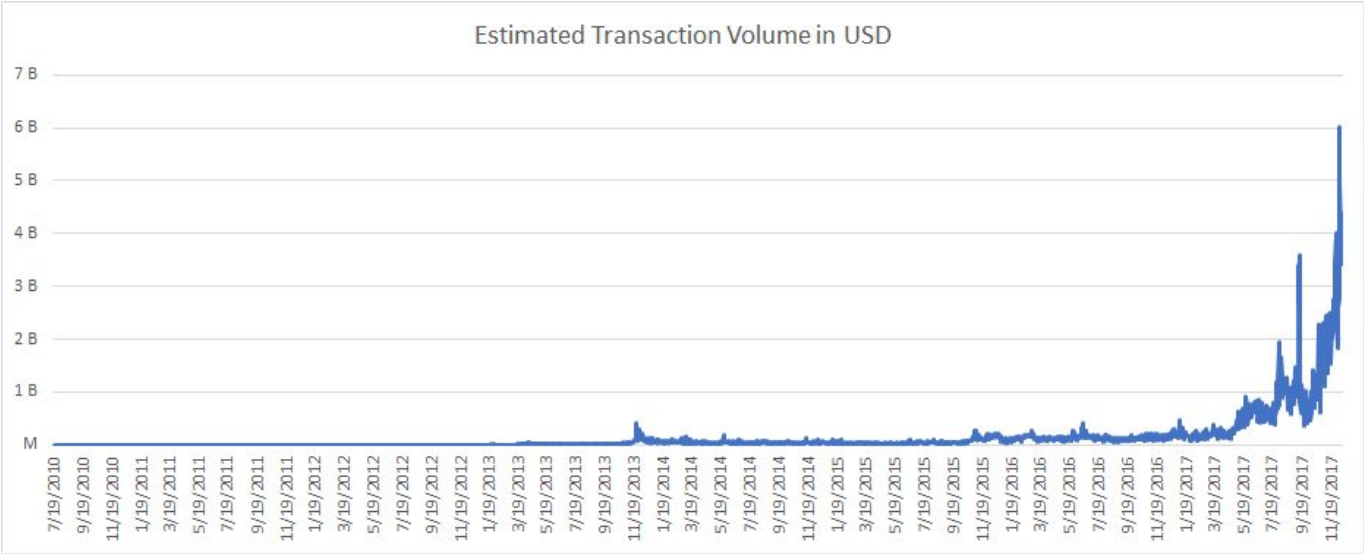
2. **Fresh Address Heuristic:** Again referencing the above example, instead of reusing one of the addresses Person A owns, some wallet software will generate an entirely new address and send the $0.50 of change to this new address. Again, this secondary transaction represents no real economic value, but instead just change. This heuristic highlights transactions in which the output of $0.50 is the first to send value to a specified address and thus eliminates additional change transactions which are normally obscured.

3. **Peeling Heuristic:** Moving away from our $20 transaction, wallet software will often decompose large outputs into a series of smaller outputs in a sequence of transactions (peeling chain). This heuristic aggregates these.

In using the above heuristics, we did not directly address exchange volume. Since most exchange transactions end up not taking place on-chain, we decided not to specifically account and put in measures to extract exchange volume from our calculations Furthermore, because the aim of NVT is to account for true economic activity, the methodology described here does not include sidechain activity (such as the lightning network for bitcoin) and exchange volume. If sidechains gain further adoption or more economic transactions start to take place off chain it could cause the current definition of NVT, specifically the calculation of transaction volume, to be unreliable. At present, however, we believe our heuristics to result in an appropriate measure of economic activity on chain.

Below are the results for estimating on-chain transaction volume for bitcoin:

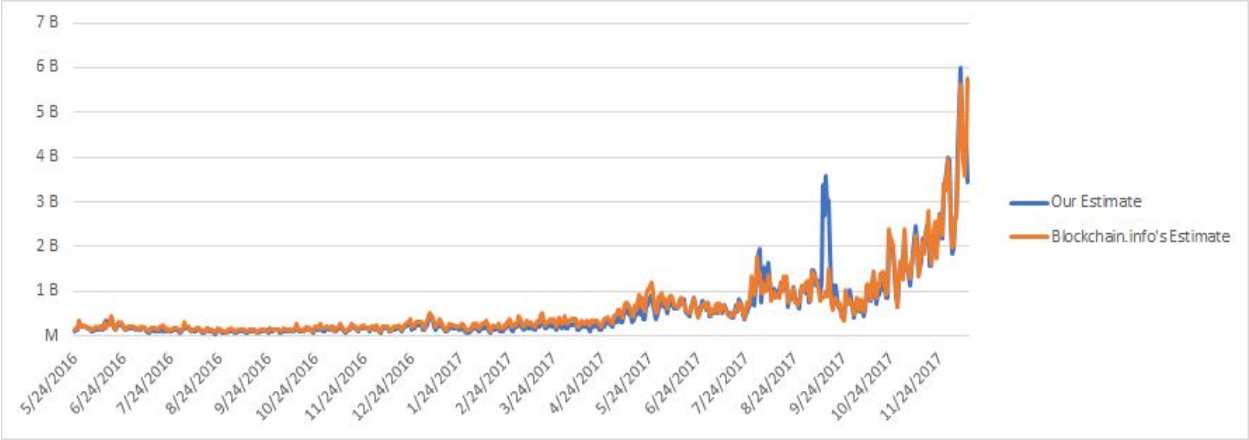




On-Chain Transaction Estimation Compare to Blockchain.info's Estimation

Since Blockchain.info provides wallet services for users, we assume this organization has enough data to accurately estimate on chain transaction volume. As such, we decided to use this estimate as a benchmark for our methodology. In doing so, it is important to note that our calculation considers one day to be anytime between 0-24:00 UTC. Any block that has a timestamp within that 24 hours is therefore included in our daily transaction calculation. However, we believe Blockchain.info uses different daily time

markers (17:00 UTC day prior - 17:00 current day). This timing difference plays some factor into minor discrepancies between our estimates. We targeted an approximation within .5 to 2 multiples of Blockchain.info. In practice, Blockchain.info estimate of on-chain transaction volume was on average 1.2 times higher than our estimate of on-chain transaction volume.

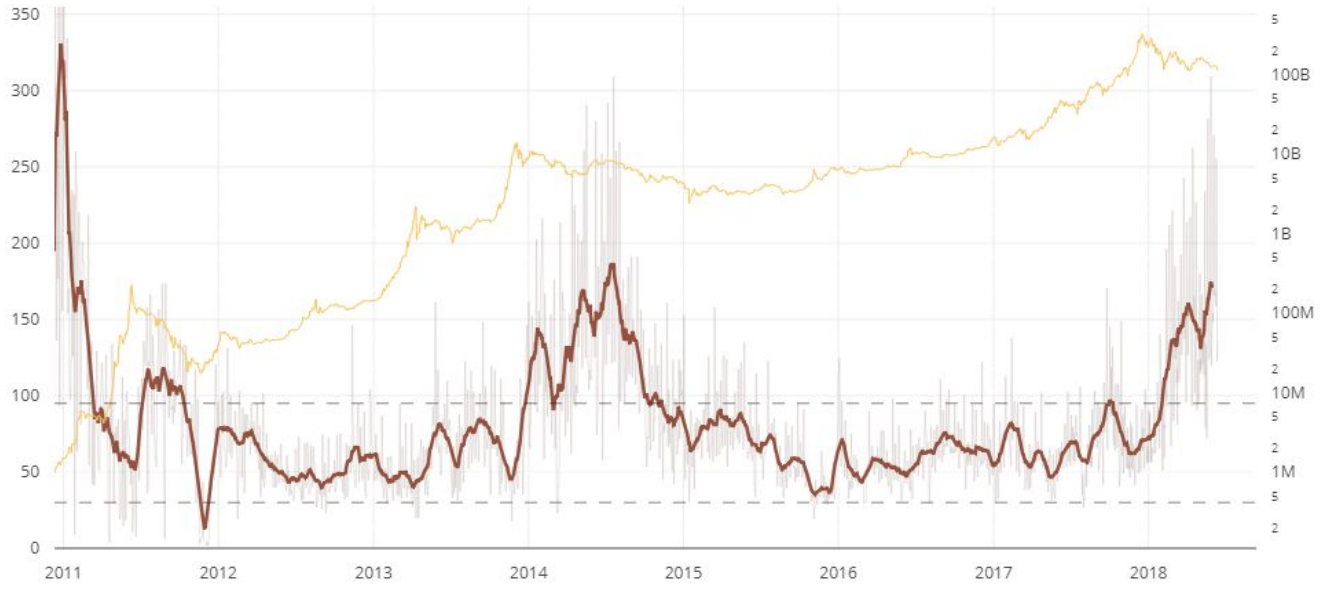


NVT of Bitcoin

Now that we have an accurate estimate of on-chain transaction volume, we can calculate Bitcoin's NVT with our estimation.

Willy Woo's NVT Chart

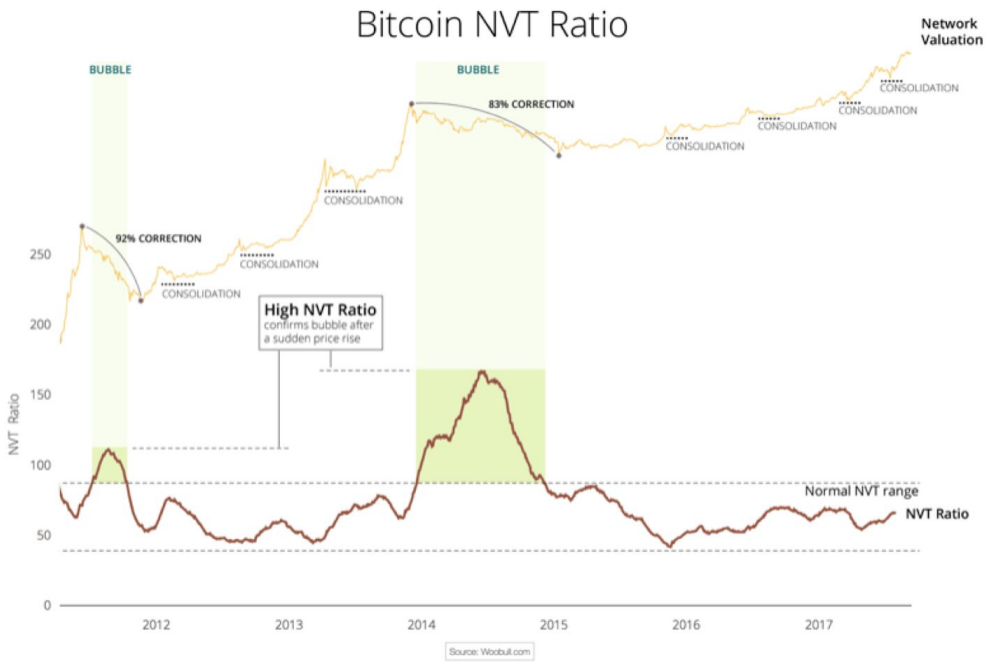
The patterns look very similar to Willie Woo's NVT chart which uses Blockchain.info's estimation of transaction volume. It is important to note that our NVT is typically higher than the one Willy Woo calculate because we are using our transaction volume estimation which is on average a factor of .8 of the estimation Woo used. Since our denominator is lower by 20%, this means our result (NVT) is naturally a higher but the overall correlation with underlying Bitcoin price remains.Now that we have an accurate estimate of on-chain transaction volume, we can calculate Bitcoin's NVT with our estimation.



Bitcoin NVT Analysis

Even absent the aforementioned data collection caveats, questions still remain about NVT's true predictive power. In looking at Woo's work on Bitcoin, NVT can be "very useful for discerning between a crash or consolidation after the price has peaked." Woo

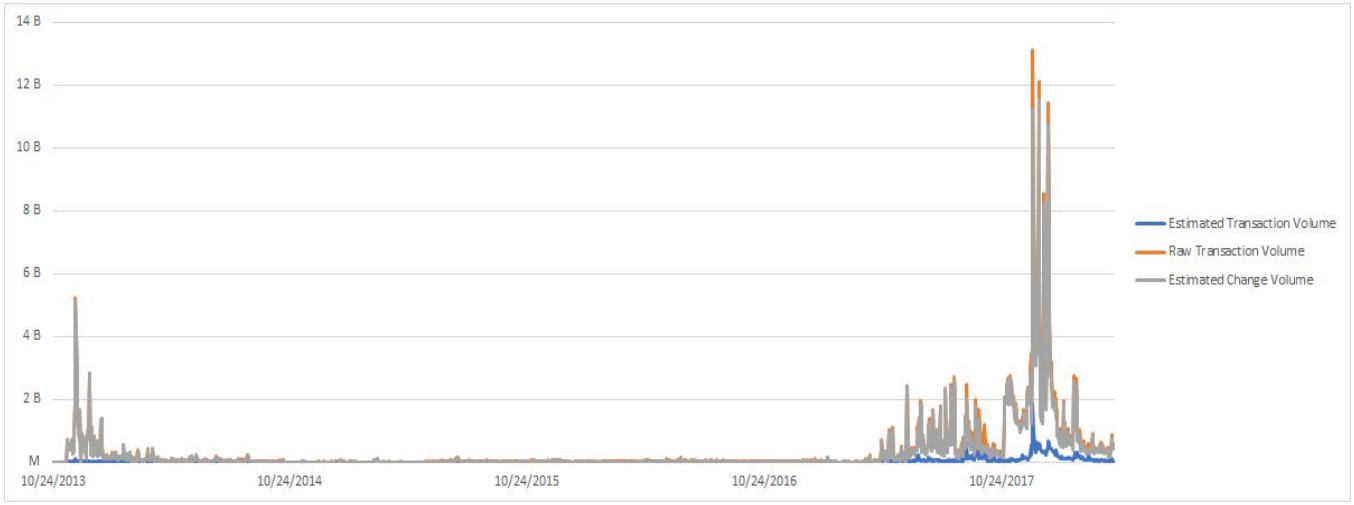
shows that NVT can detect the difference between consolidation and bubbles. If an NVT ratio stays within its historical range there is an implication that the underlying cryptoasset is not in a “bubble.” However, if NVT climbs above historical norms there is evidence to suggest that transactional activity is unable to sustain current valuation and that a significant price correction should be expected. In the graph below, we see Bitcoin’s two bubbles in 2011 and 2013: In each instance, NVT clearly signaled the subsequent 92% and 83% correction in prices, respectively.

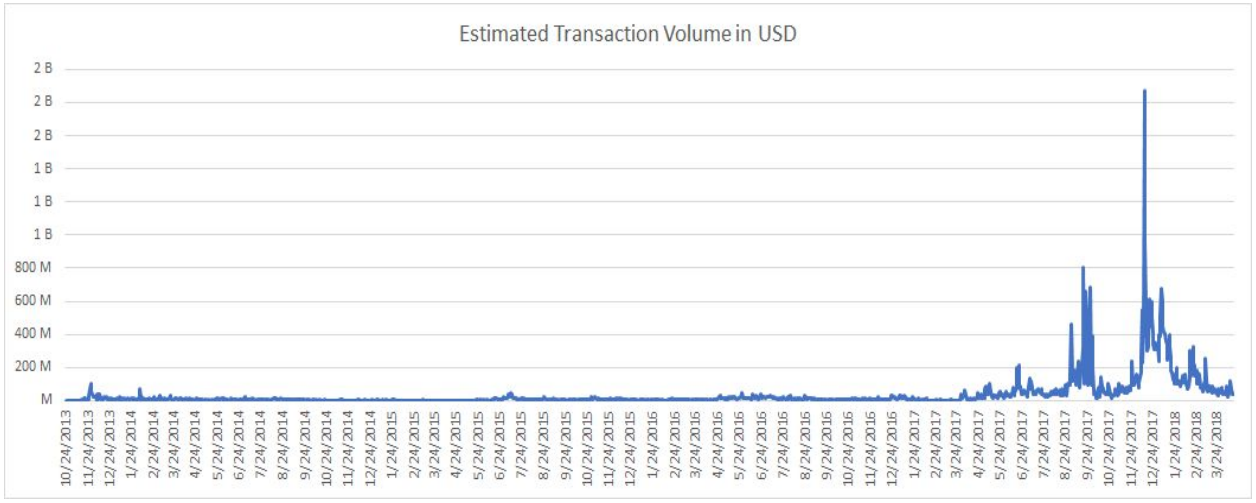


Litecoin On-Chain Transaction Volume

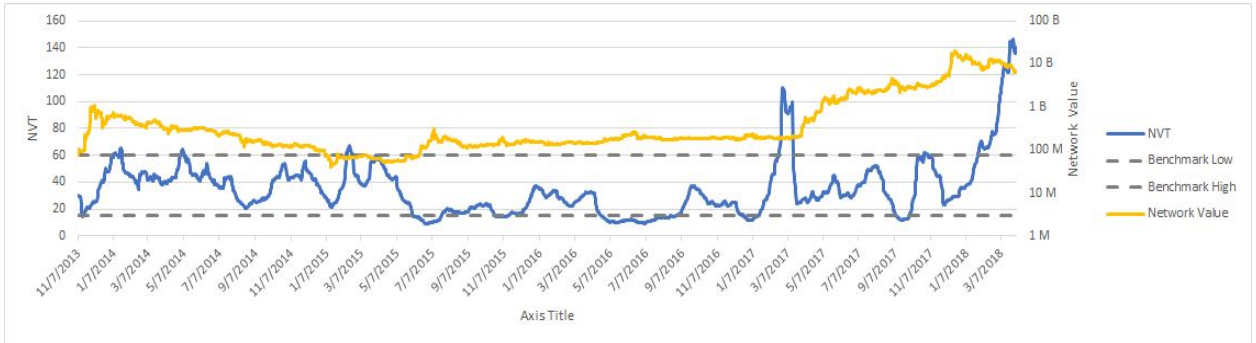
We used the same methodology (heuristic) to estimate on-chain transaction volume to estimate on-chain transaction volume on Litecoin and then subsequently apply a NVT analysis.

Below are the results for estimating on-chain transaction volume for Litecoin:





NVT of Litecoin



Litecoin NVT Analysis

After applying NVT to Litecoin using our estimation for on-chain transaction volume the team observed that NVT was not as strong as a predictor as it was for Bitcoin. We theorized that this could be because the Litecoin data set is not as robust as it is for Bitcoin, which has the most data history. Another possible theory is that there may be a minimum threshold of on-chain transaction volume for NVT to be a strong predictor or NVT benchmark lines need to be in a certain range for NVT to be a strong predictor. Therefore, we would suggest that an area for further research is to test variations of the NVT calculation to determine what provides the best estimation of value for Litecoin.

Conclusion

After applying our estimation for on-chain transaction volume to both Bitcoin and Litecoin it would seem that it's too early to validate or write off NVT as an analysis equation. Furthermore, in the future we could see some caveats for applying NVt such as there as the be a minimum about of on-chain transaction volume, or the cryptocurrency would have to be pretty established in terms of years since launch. Going forward it would be best to apply this methodology for deriving NVT to other medium of exchange cryptocurrencies and then evaluate the results periodically, because theoretically if NVT is suppose to take into account the underlying value of the cryptocurrency, the ratio should get stronger with time.

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[1]http://www.datadriveninvestor.com/2018/03/15/the-network-value-to-transactions-nvt-ratio-a-breakthrough-for-cryptocurrency-valuation/
[2]https://woobull.com/introducing-nvt-ratio-bitcoins-pe-ratio-use-it-to-detect-bubbles/
[3]https://coinmetrics.io/faq/
[4]https://lightning.network

Additional Content

Interestingly, while NVT may only hold value and predictive power for MoE coins, its relevance to Bitcoin and others could be impaired when the Lightning Network, an off-chain scaling solution, is implemented as calculating NVT's denominator would become even more involved than at present. Specifically, The Lightning Network is proposed to have scalable, low cost, instant payments across blockchains, thus deferring volume off-chain and obscuring calculations of true Chain-Transaction Value and, in turn, underlying utility. Taken from its website, "The Lightning Network is dependent upon the underlying technology of the blockchain. By using real Bitcoin/blockchain transactions and using its native smart-contract scripting language, it is possible to create a secure network of participants which are able to transact at high volume and high speed." [4]

Further detail on this process is outlined below:

- **Bidirectional Payment Channels:** Two participants create a ledger entry on the blockchain which requires both participants to sign off on any spending of funds. Both parties create transactions which refund the ledger entry to their individual allocation, but do not broadcast them to the blockchain. They can update their individual allocations for the ledger entry by creating many transactions spending from the current ledger entry output. Only the most recent version is valid, which is enforced by blockchain-parsable smart-contract scripting. This entry can be closed out at any time by either party without any trust or custodianship by broadcasting the most recent version to the blockchain.

- **Lightning Network:** By creating a network of these two-party ledger entries, it is possible to find a path across the network similar to routing packets on the internet. The nodes along the path are not trusted, as the payment is enforced using a script which enforces the atomicity (either the entire payment succeeds or fails) via decrementing time-locks.

- **Blockchain as Arbiter:** As a result, it is possible to conduct transactions off-blockchain without limitations. Transactions can be made off-chain with confidence of on-blockchain enforceability. This is similar to how one makes many legal contracts with others, but one does not go to court every time a contract is made. By making the transactions and scripts parsable, the smart-contract can be enforced on-blockchain. Only in the event of non-cooperation is the court involved – but with the blockchain, the result is deterministic.