Crypto valuation series - The equation of exchange: A flawed approach

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Since approximately 2017, there have been countless articles and blogs describing methodologies for valuing cryptocurrency via the equation of exchange, also referred to as the Quantitative Theory of Money. More recently, consensus has formed around the futility of this method, given various assumptions and common mistakes made by the authors of such valuations. In this article, we will share a review on the methodology, as well as broadly step through an example to demonstrate where the valuation breaks down, but also highlight some aspects that may offer useful insight into the driving factors of cryptocurrency value.

Quantitative Theory of Money (QTM): A long history

The Quantitative Theory of Money has a long history, dating back to as early as the 16th century, at which time it was socialized and refined for two centuries before undergoing widespread adoption in the monetary policy of the 1800's1. Economists such as John Locke, Milton Friedman, and other prominent thinkers led the efforts in its development and refinement over centuries. Such recognizable names and a long history do not absolve it from debate or controversy. Of those debating the theory, the most prominent of these is arguably economist John Maynard Keynes. Before getting into the key points of controversy, let's briefly summarize the theory as described by Irving Fisher in his popular book, The Purchasing Power of Money, published in 1911.

The Quantitative Theory of Money is a macroeconomic model that describes the relationship between the total economic output and the value of circulating money in an economy over a period of time. The relationship is debated as an identity in macroeconomic theory and has been used to better understand the impact on price levels due to changes in monetary supply as the result of various monetary policies. The equation is commonly referred to as the equation of exchange and is as follows:

Mc * Vct = Pct * Qt

- Mc is the quantity of money in the economy in the units of currency c.
- Vct is velocity, the number of times a unit of Mc is spent in period t.
- Qt is the quantity of output (in units of output) in the economy in period t.
- Pct is the weighted average price level in units of currency c per unit of output of the economy in period t.

The model states that the total value of output in an economy Pct * Qt equates to the total amount of monetary expenditures Mc * Vct for a period 2 Spoken succinctly by Smith and Crown, “the above formulation is true by definition given that goods cost what you pay for them” 3. It is worth noting that this is all in terms of currency c and has no relationship to any exchange rate to another currency.

The key assumptions of the model can be summarized in the following:

- The price level (Pct) is an exogenous factor.
- The velocity of money (Vct) and the quantity of goods and services (Qt) are not influenced by endogenous factors and are constant over the period t.
- People never hoard cash and never demand money directly, rather, they demand goods and services. The free market will naturally establish and maintain full employment equilibrium.

Economist John Maynard Keynes challenged these assumptions, even discrediting some, but most importantly he recognized that velocity was dependent upon other factors such as Pct, Qt, and Mc, breaking the second assumption. A recent example of this is the decline in M1 velocity observed during the financial crisis of 20083. A decline in GDP (Pct * Qt) in the wake of the implosion of the financial markets during the time resulted in people hoarding cash, reducing M1 velocity drastically as a result. A paper by the St. Louis Federal Reserve analyses this concept in detail for the years after the financial crisis4.

Equation of exchange for cryptocurrency valuation: Misinterpretations and flaws

Applications of the QTM to cryptocurrency first reached broad awareness with Vitalik Buterin’s 2017 article, “On Medium-of-Exchange Token Valuations,” which surmised about the effect of velocity on the value of a token5. As literature relating to this concept began to proliferate, crypto asset valuations derived from the equation of exchange followed. Thorough analyses performed by both individuals and institutions used this as a framework for assigning a fair value or price targets on various crypto assets6. Now, if you were to search the web for these valuations, you would find many detailed analyses. Due to common errors, as well as controversial assumptions that may confute the general application of QTM to the crypto space, all should be taken with a level of scepticism.

At surface level, the most common errors include the misinterpretations of the variable definitions, as well as misunderstanding the proper units. An example is the misspecification of velocity as the average time a coin is held before being transacted, rather than the total number of transactions occurring in period t. Another is the failure to properly manipulate the equation to be in terms of USD rather than the crypto asset of interest. In other cases, some falsely assume the price (Pct) is referring the price of the cryptocurrency, rather than the price level of units of output (Qt), confusing matters more. Economist Warren Weber addresses these common pitfalls in more detail in his blog and explicitly highlights the proper approach to using QTM to price the token in USD terms2. The result is the equation below (with full notation) for deriving the token value in dollar terms (P$t)/(Pct) using the equation of exchange:

(P$t)/(Pct) = (P$t * Qt)/(Mc * Vct)

But Warren goes on to say, “this raises the question of what the role tokens are playing in the project economy if the entire output is being sold for USD” and suggests the use of other models such as exchange rate models may be better fitting2.

More importantly, this equation also highlights Vct as one of the key inputs, bringing up a much more foundational issue. Per the Keynesian perspective, the velocity is dependent upon GDP and monetary supply. Put very nicely by Smith and Crown, “If velocity is, in fact, affected by changes in other QTM variables, the probability of model misspecification rises dramatically.” They continue, “using [a derived] velocity for analysis in other periods implicitly assumes that user behaviour will not change as a result of what could be dramatic changes in the asset pricing environment”3. In short, velocity depends on GDP and therefore breaks the second assumption highlighted in the section above. Therefore, we agree with the claims made by Smith & Crown, discrediting the validity of using the equation of exchange to assign a valuation to a crypto asset.

INET: The Original Valuation. Some seemingly very credible attempts at crypto valuation have been authored using QTM by various individuals and institutions, some by prominent players in the crypto space. One early example of this is the valuation of fictional coin INET back in 20177. Popularity of this methodology led to widespread adoption in the late 2010’s, with many re-employing it for their own valuation forecasts. Though based on the same flawed assumptions described above, the analysis is very thorough and gives light to some of the inner workings as to what may drive the value of a crypto economy, as well as the level of subjectivity involved. Also, by changing the assumptions of the model, the variability of the outcome demonstrates its infeasibility as a credible fair price forecast.

This overall approach to token valuation consists of three parts: forecasting the supply of the coin (Mc), determining the GDP supported by the INET token economy (Pct * Qt), and deriving a velocity Vct to use to calculate the final future value of the crypto asset. A final step of discounting the future value back to present value terms may also be applied.

For the purposes of determining the amount of circulating currency, the methodology includes the calculation of a supply schedule of the coin based upon the protocol of the cryptocurrency of interest. This provides the number of coins in float to be used as Mc at various time periods after the initial coin offering. To determine this supply schedule, assumptions are made around the percentages of tokens initially released, issued to founders, the lockup period, the percent of tokens bonded by nodes (like security deposit when joining the network), hodled, and the rates for which these may change. By applying these assumptions and forecasting them out into the future, a time series of circulating supply is the result. This serves as the Mc for different time periods in the equation above, or the supply schedule of the coin.

In the second part of analysis, the crypto economy GDP denoted in USD (P$t * Qt) is calculated based upon the goods and services transacted upon is said crypto economy. To do so, the total addressable market of the token across multiple use-cases is estimated. A few examples of these are online transactions, consumer loans, and remittance to name a few [6], in addition to the many DeFi applications that have

evolved more recently. Assumptions around market penetration and adoption rate must also be applied to calculate an aggregate future GDP value.

The last part of the analysis is to determine the velocity of the cryptocurrency Vct, which ruses the debate for the model's validity for valuation as prior stated. Many analyses assume a value for velocity based upon current fiat currencies or in line with historical values for the crypto asset of interest, which completely disregards the mutual endogeneity between the velocity and the GDP.

Though built upon a shaky foundation, this valuation methodology was so convincing and widely adopted, that many others followed, placing a wide range of value estimates for bitcoin and other crypto assets, using a vast array of assumptions. A similarly thorough approach for multiple crypto assets was performed by Crypto Research Report in 20206.

Conclusion

With such a wide array of valuations and shaky foundations based upon forecasting interdependent endogenous variables P$t,Qt, and Vct, the credibility of the application of QTM for cryptocurrency valuation comes to question. This brings us to our conclusion that the models above are useful for understanding the levers that may affect the overall value of a cryptoasset or its economy, but the foundational usage of the equation of exchange for the purpose of assigning a valuation is extremely controversial. The resulting valuations are sporadic, and often contain a vast number of debateable, or even broken, assumptions. Quantitative Theory of Money suffices as the observable macroeconomic identity outside of the Keynesian view in currency-based economies, including crypto, but going further to extrapolate a fair valuation or price target via a forecasted exchange rate would exaggerate its applicability to garner inconsistent results on questionable assumptions. As controversial as the Quantitative Theory of Money has been for centuries, adding an additional layer of complexity to exaggerate the model to formulate cryptocurrency valuations seems like an irresponsible shortcut to offer numerical support to our own speculations. More useful, may be the analysis of the market penetrations of cryptocurrencies across use-cases, for formulating various qualitative hypotheses for which cryptoassets may provide the most economic value in society.

"Due to common errors, as well as controversial assumptions that may confute the general application of [the Quantitative Theory of Money] to the crypto space, [crypto asset valuations based upon this methodology] should be taken with a level of scepticism."

This article has been drafted by Blake Heimann, Research Analyst.

1.https://www.richmondfed.org/-/media/richmondfedorg/publications/research/economic_review/1974/pdf/er600301.pdf
2.https://blog.coinfund.io/the-quantity-theory-of-money-for-tokens-dbfbc5472423
3.https://smithandcrown.com/research/cryptofinancial-valuation-series-part-two-the-quantity-theory-of-money/
4.https://www.stlouisfed.org/on-the-economy/2014/september/what-does-money-velocity-tell-us-about-low-inflation-in-the-us

5.https://vitalik.ca/general/2017/10/17/moe.html
6.https://cryptoresearch.report/wp-content/uploads/2020/06/Crypto-Research-Report-June-2020-ENG.pdf
7.https://medium.com/@cburniske/cryptoasset-valuations-ac83479ffca7
8.https://www.drwvc.com/documents/2018-08-DRW-VC-Fundamental-Valuation-of-Cryptoassets.pdf
9.https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/emeia-financial-services/ey-the-valuation-of-crypto-assets.pdf

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