Convertible Notes as a Cryptocurrency

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***Abstract*—Convertible notes are short-term debt instruments that can be converted to equity at a rate determined in the future. A blockchain based token can be viewed as equity in the blockchain whereas a convertible note can be viewed as a debt denominated in any other commodity or currency. The terms of the convertible note allow the holder to convert to the backing token with a minimum notice at the fair market price of the token. Creating token-convertible-dollars enables blockchains to grow their network effect while maximizing the return for token holders.**

I. The Problem

Creating a successful cryptocurrency requires convincing a large number of people to trade real assets for cryptocurrency assets and hold them there. The value of the cryptocurrency will grow on the order of n^2 where n is the number of people trusting their wealth with the cryptocurrency (c.f. Metcalfe's law). The problem is that price volatility limits the market of individuals willing to hold a currency to speculators willing to take a risk. This is a niche market that is unlikely to ever go mainstream.

To address this problem many businesses use payment processor services that automatically convert a cryptocurrency to a traditional national currency while guaranteeing price. These services hedge exposure to the cryptocurrency's value fluctuations through financial instruments such as options and short selling. The hedging process has fees that are often hidden in the advertized exchange rate.

While businesses have this option, individuals are less likely to use such a service. Even if these services were available to individuals the ultimate result is most people chose hold their wealth as fiat balances with the payment processor. If the payment processor is doing its job efficiently, then it likely has no net exposure to the underlying cryptocurrency. Without underlying exposure to the currency, the payment processor is doing little to support the cryptocurrencies price or network effect.

If a cryptocurrency could offer the service of hedging price volatility then many more businesses and individuals would be willing to trust their wealth to the cryptocurrency. This in turn will increase the network effect and can potentially appeal to a much larger market than speculators.

Assuming that the exchange rate between a cryptocurrency and the dollar can be reliably determined by consensus (e.g. external markets) it is possible to create a token that is always convertible into a dollar's worth of the cryptocurrency. This token would operate like a convertible note issued by a startup. If the startup is unable to repay the debt (convertible note), then the debt holder is entitled to convert the debt into equity at the future exchange rate. Likewise, if someone holds a cryptocurrency convertible note and is unable to find a buyer for it, they can convert it into the cryptocurrency.

A. Short Term Volatility

This solution depends upon implementing successful countermeasures to market manipulation. The real-time price of a token on an exchange is only loosely tied to the value of the token and depends upon the depth of the market. The price can easily be pushed up or down for short periods of time until additional capital can notice the new price and enter the market. If a cryptocurrency is going to offer unlimited guaranteed conversion to a dollar's worth of tokens then it needs to be sure that the price it uses isn't a short-term artifact but a long-term estimation of value.

B. Price Depends on Quantity

There isn't a single "price" for anything. The more you attempt to buy or sell the higher (or lower) the price often goes. This price someone pays for 1 share of stock is often lower than the price they would have to pay to buy 1 million shares of the same stock. Every share purchased removes a seller from the market and the next seller is asking more than the last. Someone who wants to convert $100 into Apple stock will pay much less per share than someone who wishes to instantaneously convert $100 million into Apple stock. Unfortunately there is no analytical formula which can determine a price based upon quantity without modeling market participants.

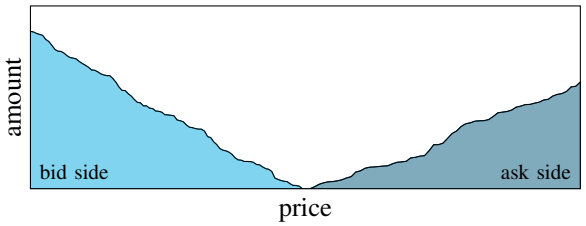

Fig. 1. Illustration of market depth

C. Price Feed Latency

Professional traders take advantage of automated trading algorithms that can respond to price changes in under a second. Any external price feed is guaranteed to lag the real market which means trading bots can take advantage of short term discrepancies between market prices and the price feed. Robust price feeds likely integrate data from multiple sources and are therefore likely to have larger lag times.

D. Price Feed Quality

Assuming all other issues can be resolved, users will ultimately be placing their trust in the quality of the feed. This means they are ultimately trusting the feed producers. If the feed producer publishes a price that is below a dollar then it would cause the dollar token to be worth less than one dollar. The more uncertainty there is on the quality and reliability of the price feed the less market participants will want to trust both the cryptocurrency and the convertible tokens.

There are many ways that a feed producer can produce the wrong feed. First, the data they get from exchanges can be wrong or corrupted. Their system could be compromised or their mixing algorithm could be wrong. In the event that an exchange defaults the value of an exchange dollar may no longer be worth a real dollar causing a price feed from that exchange to no longer serve as a reliable proxy.

E. Sustainability of Debt to Equity Ratio

Assuming all of the above problems can be resolved, there remains one significant issue to be addressed: the debt to equity ratio. If a token is viewed as equity, then a token-convertible-dollar can be viewed as debt. If the debt to equity ratio gets too high the entire currency can become unstable. Debt conversions can dramatically increase the token supply, which in turn is sold on the market suppressing the price. Subsequent conversions require the issuance of even more tokens. Left unchecked the system can collapse leaving worthless equity backing a mountain of debt. The higher the debt to equity ratio becomes the less willing new investors are to bring capital to the table.

II. The Proposed Solution

Creating reliable token-convertible-dollars requires a combination of a reliable price feed, rules to prevent abuse, and liquidity. Providing a reliable price feed involves three factors: minimizing the impact of timing, maximizing the cost of producing an incorrect feed, and minimizing the impact of an incorrect feed.

A. Mitigating Timing Attacks

To reduce the impact of time on the valuation of a cryptocurrency token the price used must be a moving median and there must be a delay between when a conversion request is made and when it gets executed. If the delay is greater than the period over which the price is averaged then the blockchain and trading bots are on equal footing when it comes to predicting the future average price. So long as the average period and delay involved is longer than the duration that large market manipulations can be sustained, it will be expensive and difficult to take advantage of the blockchains conversion rate.

B. Minimizing Fraudulent Feeds

The most basic approach is to elect individuals to publish feeds. These elected individuals are presumably trusted by those who have a vested interest in the quality of the feed. By paying those who are elected it will create market competition to earn the right to produce feeds. The more the feed producers are paid the more they have to lose by publishing false information.

Given a set of trusted and elected feed producers, the actual price can be derived as the median of the feeds. In this way if any individual feed producer produces an outlier it has minimal impact on the actual median while still having the ability impact their reputation.

If the median price feed gets corrupted for a short period of time it should also be factored out of the equation. For that reason, the conversion rate should be specified as a moving median instead of a moving average. As long as the price feed corruption lasts for less than half the moving median time window it will have minimal impact on the conversion price. This means network participants will have an opportunity to vote-out corrupt feed producers before the corrupt feed can impact the conversion price. Perhaps more importantly, it gives feed producers an opportunity to detect and correct issues before their feeds start impacting the price.

C. Minimizing Abuse of Feeds

Any time there is a short-term aberration of the price feed there is temptation for traders to use it as an arbitrage opportunity. If the feed were off by 25% or more then everyone would rush to convert at the favorable prices at a significant cost to the blockchain. The price of conversion must be contingent upon the quantity of conversion requested. If there is a large demand for conversion it implies that the price feed is too biased.

The conversion rate should be proportional to $(1-q)^2$ where q is percent of total dollars being converted to tokens. If a small percent is being converted then it will receive near the full price feed. As the percent of outstanding conversion requests increases the conversion price starts to fall rapidly. This falling conversion price puts a natural rate-limit on conversion requests.

If the conversion rate is unfavorable it is possible that no one will request conversions. Under this scenario vested stakeholders in the underlying token have financial incentive to correct the price feed before it causes lasting damage to the network effect as the dollar notes break the peg. The lack of conversion requests can occur naturally anytime demand for dollar-pegged assets is higher than the supply.

D. Two Way Conversions

It is necessary to provide two way conversions in order to balance supply and demand. If the demand for convertible dollars is higher than the supply available at a dollar then they would start to trade for more than a dollar. This deviation would impact many market participants. By offering a two-way conversion token holders can convert from tokens to convertible-dollars then sell the convertible-dollars on the market at profit.

III. Liquidity

Just because a convertible-dollar can be converted to a dollars worth of tokens at a fair price in a reasonable amount of time doesn't mean it will be viewed as a reliable dollar replacement. These assets require liquidity in a market that enables instantaneous conversion between tokens and convertible-dollars. The measures a blockchain is forced to take to prevent abuse end up lowering the quality of the convertible dollars. To compensate for this loss of quality the blockchain can offer a fixed cost reward to liquidity providers. Whereas the potential losses from manipulation and abuse are unbounded, the cost of encouraging liquidity can be fixed.

A liquidity provider buys and sells convertible-dollars and tokens. They take on the majority of the short-term price risk and long-term feed risk giving the remaining market participants a high quality, extremely liquid market within which to trade.

To encourage liquidity the blockchain needs to reward people who leave open orders on the book that get filled after a reasonable amount of time. If an order is open for too short a period of time then it encourages artificial volume through self-trading.

Every order that is filled after being on the books for at least the minimum period of time should receive a fraction of the daily liquidity reward proportional to their share of the daily qualified volume.

$$\text{UserVolume}/\text{TotalQualifiedVolume}.$$

IV. Sustainable Debt to Equity Ratios

Let's assume a conservative debt to equity ratio of 10%. Any time the debt is above 10% of equity the blockchain will need to offer financial incentives to convert debt into equity. The easiest way is to offer a more favorable conversion price. The further the ratio is above 10% the more favorable the conversion price needs to be. When debt is converted to equity the resulting equity can either be held or sold. If it is held then the price of the token will grow, if it is sold then the token will fall in value.

The idea behind having a conservative 10% debt to equity ratio is that even if all debt were converted and sold there should be ample buyers and the effective dilution of the token holders remains relatively small.

V. Benefits

We presume that those who hold tokens in a blockchain do so because they expect future profits that are proportional to the risk they are taking. When it comes time to hire someone to do work on behalf of the blockchain the only thing of value the blockchain has is its tokens. When the worker receives the payment they have to decide whether or not they want to invest in the blockchain or sell to guarantee they have the income to cover their costs (and taxes). Often the worker decides to sell and the result is the market value of the token falls.

It is in the interest of the token holders to encourage the worker not to sell as this will prevent the token's price from falling. If the tokens rise in value then the token holders gain the profit because the convertible note will convert to fewer tokens in the future.

In other words, if a blockchain issues convertible notes then it can postpone its need to raise capital until it has achieved a wider network effect. In addition to postponing sell pressure a convertible note increases the capital held by the network. The worker who received a $500 convertible note effectively lends this value to the blockchain. Because the note is convertible into tokens on demand it represents an effective $500 increase in market capitalization. This can be visualized by viewing the market capitalization as

$$\begin{aligned}\text{cap} &= \text{price} \cdot (\text{supply} + \text{debt}/\text{price}) \\ &= \text{price} \cdot \text{supply} + \text{debt}.\end{aligned}$$

A blockchain token is a social currency that is designed to track equitable ownership in a social network. Everyone who contributes work to the blockchain should receive a pro-rata percentage of ownership in the network. All arguments regarding inflation, deflation, or fixed supply currencies are irrelevant to the measurement of equitable contribution. A blockchain benefits anytime the number of participants willing to trust the network's tokens with value grows. By offering a convertible note a social network can attract new members who are more risk averse than the token holding speculators. This arrangement benefits both parties, the token holders grow their network effect and the market cap of their token while increasing their long-term gains if the network grows. In the event the token fails to grow in value those who receive the convertible notes end up owning a larger percentage of the smaller pie.

A convertible note can be made fungible, divisible and transferable. With these properties it will trade near parity anytime the market believes in the value of the tokens backing the debt. Ultimately the only way for the holder of the debt to get paid back is to find a new holder or to convert to tokens and sell the tokens to an investor. If tokens are viewed as equity, then when the debt to equity ratio is low the market will have high confidence in the value of the debt but when it gets too high the market equilibrium becomes less stable. People may attempt to sell the debt and find no buyers at parity, so they convert to tokens and sell to investors. The value of the tokens can fall significantly, but this doesn't impact the convertible note until there are no buyers for the token at any price.

It is in the financial interest of both the token holders and the convertible note holders to protect the value of the token. When a convertible noteholder converts to tokens with the intent to sell they will make the most money by selling slowly over time as market liquidity allows. If a noteholder is concerned that their sell pressure will lower the token price then they will only convert a small percent of their notes at a time leaving the rest of their notes protected. The complexity involved in converting notes to cash or tokens will be dealt with by professional traders who provide liquidity to the dollar/note and the dollar/token markets.

VI. Conclusion

Token-convertible-dollars enable blockchains to grow network effect by creating price-stable crypto currencies with a tight peg and high liquidity.