Value Capture & Quantification: Cryptocapital vs Cryptocommodities

Since publishing the new asset class white paper in 2016, defining and valuing the diverse set of cryptoassets before us has been a long-running obsession of mine. Iterations have come as experiments and empirical observations flow in – this paper is a continuation of that exploration.

What follows is a description of the two main buckets of cryptoassets we are seeing today (capital and commodities), which then feeds into a discussion of the differences we can expect in the value capture and valuation models between the two. It is both a revision and expansion of Cryptoasset Valuations, driven in part by the explosion of stake-based assets since 2017, which as productive assets don't fit the MV = PQ model.

The piece is not meant to be exhaustive or descriptive at a technical level, but rather to offer two primary directions for future valuation work. While I've put the words to paper, I consider these ideas to be my interpretation of the collective output of the last year of conversations with Joel, Brad, Alex, Mario and the broader crypto community.

The majority of cryptoassets are shaping up to be *capital assets* in nature*,* whereas many early examples like bitcoin are better characterized as commodities, with a subset poised to become commodity monies. Within the burgeoning *capital asset field of crypto*, some closely resemble equity, others more closely resemble debt, and others have a bizarre enough mix of capabilities and value streams to be unrecognizable from prior renditions of capital assets. As part of explaining why governance assets have value, Joel has done an excellent job of laying out foundational principles behind capital, which is a piece that should be read before continuing here.

Following the economic interest can lead us to key defining characteristics that bifurcate the world into cryptocapital and cryptocommodities. This bifurcation creates a fork in the road for how to value these two groups of assets.

The TLDR is that cryptocapital will take inspiration from its capital asset peers, and as a *productive* asset its value will be calculated as the net present value (NPV) of annual value flows to supply-siders. Meanwhile, the equation of exchange (MV = PQ) remains our best bet at pricing *non-productive* cryptocommodities, where PQ = annual transaction volumes using the native asset. Note that "annual value flows to supply-siders" and "transaction volumes" are separate metrics, and serve as the respective linchpin metrics for cryptocapital and cryptocommodities.

A mistake I made in 2017 with *Cryptoasset Valuations* was to suggest MV = PQ could be used for all cryptoassets, whereas it's now clear to me the equation only applies to the non-productive subset of cryptoassets. As this world of programmable value unfolds before us, making mistakes, acknowledging those mistakes, and learning from them, is part and parcel of iterating towards the truth.

In the search for valuation models to explain the prices we see, valuing cryptocapital will be less foreign to equity and bond analysts than pricing cryptocommodities, which should accelerate the number of analysts contributing to the "theory follows price, price follows theory" effort. Converging on consensus models to value cryptoassets is essential to improving the efficiency and thereby stabilizing the volatility of the crypto markets.

Asset Superclasses

A bit of context to set the stage for delineating between cryptocapital and cryptocommodities. Broadly, there are three *superclasses of assets*, under which most of what we consider to be "asset classes" fall. Below is a table from the 2016 ARK and Coinbase new asset class white paper, with descriptors pulled from Robert Greer's 1997 paper, *What is an Asset Class Anyway?*

TABLE 1
Categorization of Traditional Asset Classes by their Superclass

	CAPITAL ASSETS "Ongoing source of something of value…valued on the basis of net present value of its expected returns."	**CONSUMABLE/ TRANSFORMABLE ASSETS** "You can consume it. You can transform it into another asset. It has economic value. But it does not yield an ongoing stream of value."	**STORE OF VALUE ASSETS** "Cannot be consumed; nor can it generate income. Nevertheless, it has value; it is a store of value asset."
EQUITIES	x		
BONDS	x		
INCOME-PRODUCING REAL ESTATE	x		
PHYSICAL COMMODITIES (e.g., grains or energy products)		x	
PRECIOUS METALS (e.g., Gold)		x	x
CURRENCY			x
FINE ART			x

Source: "What is an Asset Class, Anyway?" Robert J. Greer, 1997, The Journal of Portfolio Management

Per Greer:

- Capital Assets (CA): "Ongoing source of something of value… valued on the basis of net present value of its expected returns." Obvious examples are equities, bonds, income producing real estate, and so on.
- Consumable/Transformable Assets (C/T): "You can consume it. You can transform it into another asset. It has economic value. But it does not yield an ongoing stream of value." Oil, wheat, natural gas would singularly fall into this bucket, while some precious metals and scarce commodities are C/T assets but also socially accepted stores of value (overlapping with the 3rd superclass).

- Store of Value Assets (SoV): "Cannot be consumed; nor can it generate income. Nevertheless, it has value; it is a store of value asset." Assets like art, collectibles, and fiat currencies are purely stores of value of varying quality, while the SoV superclass also has overlap with the rarer consumables/transformables.

An asset can fall across multiple superclasses, but historically blended assets have been a mix of a C/T and SoV asset, as is most clearly the case with gold. With many cryptoassets we are seeing an explosion of blended *capital assets and consumables/transformables (CA + C/T),* which is a more foreign combination.

This doesn't de-facto mean these "CA + C/T" cryptoassets fall under existing securities laws, because most of them require active participation in order to receive value flows, and as the SEC has recently pointed out, "Usually, the main issue in analyzing a digital asset under the *Howey* test is whether a purchaser has a reasonable expectation of profits (or other financial returns) derived from the *efforts of others*." The "efforts of others" is much more nebulous in cryptoland when compared to the clear cut lines of traditional corporate entities.[1]

Even if such "CA + C/T" cryptoassets are ultimately labeled securities and regulated by the SEC, they still include supply-siders in the value stream and capital appreciation of the service, as opposed to equities where investors *passively* claim the profits of the entire system. While subtle, this inclusive shift is an important component of leveling the playing field against pure capital allocators. I say this as a capital allocator that sees how uneven the current playing field is.

[1] Careful readers will rightly ask, why not just use an equity to capitalize the network? In some cases, an equity-based capitalization mechanism will work better as the principal-agent model, in other cases a cryptoasset will be superior. Some reasons a cryptoasset may be superior include:

- Once we have accumulated more learnings and best practices from our current trials and tribulations, software-based governance of cryptonetworks could be more finely tuned and evolve faster than the paper-law of equities.
- Capital allocators have a harder time passively extracting value flows, and don't get an infinite claim on value flows for merely capitalizing the system at the beginning. Furthermore, laborers can add leverage to their efforts with capital. Together, this should even the currently very unfair playing field between capital and labor, though we will have to watch where passive value extraction goes with staking-as-a-service providers popping up to service large capital allocators.
- Everyone involved in the network can have skin in the *same* game, which per Taleb's "skin in the game thinking" should lead to optimal economic behavior because people with real risk are directly accountable for their actions.
- Given each protocol has the potential to operate as globally as TCP/IP from inception, these networks can potentially scale geographically much more quickly than company-provisioned-services can.

Capital Assets (CA)

Capital assets, under Greer's framework, are an "ongoing source of something of value… valued on the basis of net present value of its expected returns." These are productive assets, in that holding them gives claim to a stream of "something of value." It should be immediately obvious how different this is from bitcoin, where the holder of BTC gets no ongoing claim. While we traditionally think of "something of value" as being cash flows, Greer's word choice leaves the field of value open to interpretation.

Any cryptonetwork that requires ownership of the native cryptoasset to gain access to a recurring value stream generated by the network, thereby creates a capital asset as opposed to a commodity.

Translating this to cryptoland, any asset that is staked, bonded, or otherwise committed in order to get a claim on value flows can be considered cryptocapital. A sustainable value stream comes from transaction fees and asset inflation, though the latter is not strictly needed. The steady flow of transaction fees assumes the network is providing a valuable service, which is an assumption we'll have to make if we believe these assets can effectively and sustainably coordinate resources as well as existing social contracts (e.g., equities).[2]

Assets that yield this *ongoing source of something of value* can generically be approached using the NPV of the network's annual value flows to supply-siders. Some will more quickly grasp it as a Dividend Discount Model (DDM), except instead of summing all of a company's future dividends and discounting back to present, *you are taking the net present value of all value flows that are expected to go to the supply-side over time.* Others may prefer to view it as an adapted discounted cash flow (DCF) model, though there I would prefer the term discounted value flow (DVF) be used.

Just because the asset is coordinating the supply-side doesn't mean the end-consumer needs to interface with it. In fact, as of spring 2019, most capital assets in the market today are predominantly supply-side instruments. If the asset is used entirely as cryptocapital with no

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[2] If cleverly constructed, the capitalization and governance mechanisms of the system 1) attract a willing supply-side that produces the resource 2) connect that resource to a demand-side that values and is willing to pay for the resource 3) creates an *open layer of access to the underlying resource* for distributors that want to build the last mile to the consumer.

Generally the network demands some kind of cost to be incurred to get access to the value stream of the network (no free lunch). Currently, the three most common costs demanded are 1) staking/bonding the native asset, an internal capital cost 2) running machines that perform the services of the network, an external capital cost 3) participating in the governance of the system, a human cost in the form of pure labor. Note that cryptocommodities tend to only demand #2 (external capital cost), whereas cryptocapital networks can demand all 3 as inputs of work to get access to the value stream of the network.

Some have referred to cryptocapital as the taxi-medallion model, or *work tokens*. Work tokens are part of the picture of cryptocapital, but refer more to the *equity side of the equation.* There's certain to be a whole *debt side of cryptocapital*. Intriguingly, while the debt markets are ~3x larger than the world's equity markets, it has been much less explored in crypto to date.

consumable/transformable application, then *the "velocity-problem" is not at all a problem*; velocity never makes its way into the valuation model.

If, on the other hand, the asset has utility beyond merely being a supply-side coordinator then the non-staked, non-productive asset base can be used in a consumable/transformable capacity. This raises the question of whether velocity enters the equation for CA + C/T hybrids, where the CA component is DVF'd and the C/T component could be MV = PQ'd. In such a scenario, I'd expect the vast majority of the asset's value to come from the DVF instead of M = PQ/V, making velocity in the C/T component a minor point. The question still leads us to one of the challenges that remain in valuing these assets, which I've footnoted for the casual reader's sake.[3]

While I've spent the majority of this section fixating on the capital asset component of a "CA + C/T" asset—in part because I think the CA component generates the majority of value capture in such assets—the potential utility of the consumable/transformable component should not be overlooked. Due to their infinite programmability, we are going to see all kinds of variety in the benefits offered through C/T uses, with a few obvious ones already being discounts, access, and reputation.

[3] Challenge 1: Heterogenous composition of a cryptoasset's value for capital assets that have a consumable/transformable component. As an example, such an asset could be 65% staked, 25% circulating for the consumable/transformable component, and then 10% hodl'd by investors or locked in other capacities, such as the recent lockdrop trend. My original intuition was to approach the valuation as a *sum of the parts* where the capital asset component is DVF'd, the circulating is MV = PQ'd, and the two are summed for the current market price. The hodlers would just drag down the velocity of the MV = PQ component, but would not be part of the DVF, nor would they command an independent model as the subjectiveness of the *financial premium* they assign to store of value assets is notoriously capricious. That said, Rustam Botashev mostly talked me off this ledge with the argument that such a sum of the parts approach should only be used *intra-DVF* or *intra-MV=PQ*, not as a combination of the two. Otherwise you get split user bases with different market prices for the assets, which are not additive, ultimately making no sense. An easy solution is to ignore the MV = PQ component as the vast majority of value for cryptocapital should come from the DVF, but that's not very satisfactory :-)

Challenge 2: Value flows being distributed in the native cryptoasset requires an exogenous assumption to form a base of value, and even then, the supply-side's assessment of the value they're receiving can be unpredictable given the native asset's volatility. There are a few ways out of these conundrums. One is to make the assumption that at equilibrium the service should be ½ to 1/10th the cost of a service provisioned by a company comparable (e.g., storage at 1/10th the cost of AWS), as only networks that are more efficient than companies will be able to get demand-sides to make the leap (unless it's a novel or highly differentiated service). The cost of the service can then be pinpointed, the units of the service consumed can be projected, and the product of the two is the value stream flowing to the supply-side. That value stream is what the cryptocapital has claim to, and so the *capital asset* component of value can be assessed. To reiterate, here the exogenous anchor is the cost of comparable services that the cryptonetwork will be competing with, though trouble remains if the native cryptoasset is too volatile, as that volatility influences the supply-sides' perception of what they're getting paid. A potential solution is the value flow that the supply-side receives, and the demand-side uses, is denominated in a stable-ish asset (e.g., stablecoin, bitcoin, fiatcoin, credit card, etc). The net present value of these collective value flows can then be derived similarly to a traditional equity, without the added complication of the native asset's volatility as part of the payment stream. *In such a scenario, the native cryptocapital could still accrue significant value while not being the payment medium.*

Consumable/Transformable (C/T) Assets

With a pure consumable/transformable asset, under Greer's framework, "You can consume it. You can transform it into another asset. It has economic value. But it does not yield an ongoing stream of value." Because it doesn't yield an ongoing stream of value, *there is no ongoing value flow spinning off from the native asset to govern*, and the capital nature of these assets falls away. Instead, they can be approached as commodities.

In my mind, any purely proof-of-work asset can be considered a cryptocommodity, and MV = PQ remains our best bet at pricing such assets.

Proof-of-work assets are the main C/T assets that I can think of in crypto,[4] and they have created a *digital native commodity in the form of secure, globally accessible ledger space*. One of my mistakes early on, including with Cryptoasset Valuations' INET model, was to assume that because a network is provisioning a commodity-as-a-service, the native asset that enables that service is a commodity. As described in the capital assets section, most such examples in the market today actually function as a capital asset.

To reiterate, the key differentiator boils down to whether the internal asset of the system must be staked to participate; if it must, then that asset is a requisite to receive value flows, and it becomes a capital asset.[5] If the internal asset is not one of the inputs to production, then it's likely we have a cryptocommodity on our hands.

To value these cryptocommodities the best iteration laid out thus far is from Rustam Botashev of HashCIB, which built upon the work Brett Winton and I did while at ARK Invest (next page):

[4] Or maybe I'm merely not seeing them— am very curious to hear what others may think are native *cryptocommodities*.

[5] Since there's not a value stream that flows back to asset holders, a cryptocommodity has different needs for governance, which can partly explain the Bitcoin community's dumbfounded reaction to much of the rest of crypto's fascination with governance (where the majority, by number, of assets are shaping up to be cryptocapital). Furthermore, with a global money that is rebelling against how things have been done in the past, the lack of any formal governance may protect bitcoin from attack.

We introduce our in-house approach to value blockchains. Our approach is based on methodology proposed by both Chris Burniske and Brent Winton. We derive each period's blockchain current utility value (CUV), which at any given period **t** is forecast by the equation of exchange: $CUV_t = P_tQ_t / V$. The rational utility value of a network is not just the discounted future CUV[1] of a particular year, nor is it the sum of discounted CUVs of all projected years[2], we believe. We think that blockchain's rational utility value is better modelled as **today's** utility value **plus** discounted **additional** current utility values (ACUV) for every year to infinity. $ACUV_t$ in a year **t** equals the difference between CUV_t in the year **t** and CUV_{t-1} in the year **t-1**.

$$\mathbf{ACUV_t = CUV_t - CUV_{t-1}}$$

To account for infinity, we calculate the terminal value (TV) of ACUV at the period of network maturity. In this case, the model captures all the years. The approach is similar to the one used to value banks, for which traditional DCF is not applicable. A financial institution is valued as a sum of its current shareholders' equity and the present value of future excess returns on equity (returns in excess of those required by the cost of equity).

The commonalities and differences of our approach are easier to explain with a simple example. Consider a network that matures in five years and subsequently grows with the annual rate **g** indefinitely. CUV_t is network's utility value for the end of year **t**. The additional utility value $ACUV_t$ for the period **t** is equal to $CUV_t - CUV_{t-1}$. TV for the end of the year five equals $ACUV_6 /(r-g) = ACUV_5*(1+g)/(r-g)$. This is a classic formula for terminal value, where **r** is the discount rate.

	Year 0	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Terminal Value**
CUV	CUV_0	CUV_1	CUV_2	CUV_3	CUV_4	CUV_5	
ACUV		CUV_1 minus CUV_0	CUV_2 minus CUV_1	CUV_3 minus CUV_2	CUV_4 minus CUV_3	CUV_5 minus CUV_4	$ACUV_5*(1+g)/(r-g)$
Discount rate	1	1+r	$(1+r)^2$	$(1+r)^3$	$(1+r)^4$	$(1+r)^5$	$(1+r)^5$

Source: HASH CIB

We would hesitate to call the number generated by this approach a "target" or "fair" price, given that the model only applies for coins with utility value and for developing blockchains. We would instead call it a **Rational Network Value (RNV)**. In the example above, the RNV would be as follows:

$RNV = CUV_5 / (1+r)^5$. Burniske model

$RNV = \sum CUVt/(1+r)^t$, *where* $t = 0 \ldots 5$. Multicoin Capital model

$RNV = CUV_0 + \sum ACUVt /(1+r)^t + ACUV_5 *(1+ g) / (r-g) / (1+r)^5$, *where* $t = 1 \ldots 5$. HASH CIB model

It's no secret that MV = PQ, which underlies the model above, has been contentious within crypto and in the broader field of economics. Some have gripes with it because it's an identity, while others complain about the accuracy of the data that goes into the model. With physical commodities, data is much more opaque and splintered than it currently is with cryptocommodities, rendering MV = PQ mostly useless in the physical realm. With the current instantiation of cryptonetworks the data is shared, open, and free,[6] which gives me hope we will be much more able to gauge the supply and demand drivers that become inputs to MV = PQ models in cryptoland.

[6] Though it should be noted with the growing tidal wave of zk-SNARK and STARK implementations it's unclear how long this economist's dream is due to last.

That said, we can have perfect data and what appear to be well-reasoned assumptions that we plug into these models, and still be lost if we don't understand a few key dynamics behind how humans have historically interpreted the value (or lack thereof) of highly used commodities.

While there's a whole industry that speculates on pure consumables/transformables (commodities are high volatility!), it's the commodities that overlap with the SoV superclass that can be good places to diversify wealth over the long term. *Assuming a commodity's ability to stay relevant in its use over time, society's perception of it as a good SoV is then highly dependent on the commodity's annual rates of supply inflation, and the predictability of those rates of supply-inflation in the years to come.* Saifedean Ammous did a good job in the The Bitcoin Standard of hammering this point home.

While people will fixate on present rates of supply inflation, the ability (or lack thereof) to change the annual rate of supply inflation in the future is just as if not more important, and can be thought of as the commodity's *hardness.* The harder it is to create new supply that dilutes the existing stock, the harder the commodity can be considered, and the better its chances at serving as a SoV over time because people can have faith that their ownership percentage of the outstanding stock is not going to be significantly diluted.

"Soft commodities" like oil will create as much supply in a year as there was pre-existing stock, whereas "medium commodities" like silver may create 20% as much supply in a year as there was pre-existing stock, and then "hard commodities" like gold only pump out 1-2% supply inflation in any given year.[7] If Bitcoin remains steadfast in its monetary policy, then when it converges upon 21 million units with 0% annual supply inflation it will have achieved perfect hardness. Perfect hardness is only possible in the digital world.

Anyone building or investing in a cryptoasset that is a consumable/transformable at its base, with zero cryptocapital characteristics, needs to be cognizant of the above dynamics. Few commodities make the leap into being considered reliable SoVs, and crypto will be no exception. For the cryptocommodities that don't achieve the financial premium associated with SoV assets, their value capture prospects are grim.

This point has been beaten to death, and is one of the reasons "utility tokens" have become so despised. In my mind, the term "utility token" is too vague to be of use. If there's a utility token that's a consumable/transformable asset without a credible pathway to becoming a SoV, then it will suffer from the velocity problem and capture little value. If, on the other hand, its utility is as a stake-based supply-side coordinator and the asset falls under the cryptocapital bucket, then so

[7] Paraphrasing data from "The Bitcoin Standard" by Saifedean Ammous.

long as the network is providing an in-demand service then the asset's value capture prospects are brighter.

A last note: commodities are typically thought of as having a floor at their marginal cost of production. In the 2014/2015 bear market, and again in our current 2018/2019 bear market, we've seen reports of bitcoin miners nearing their marginal cost of production in the $200s and $3000s, respectively. The ~$200s was the bottom for bitcoin in 2015, and the low $3000s may be the bottom for our current bear market. If miners refuse to sell below their cost of production this may be enough to tip order books in a positive direction, enforcing the marginal cost of production as a floor. Due to the difficulty adjustment, however, bitcoin can theoretically face a downward spiral in the cost of production, putting some kinks in the theory behind what is empirically promising.

A couple things that are different from physical commodities:

- In a digital world, there is no natural consumption/destruction of the commodity (beyond lost keys) the way there is in the physical world. While this allows the cryptocommodity's stock to accumulate nicely over time, it also requires the supply of the asset be mindfully constrained through mechanisms such as forced burning or extreme scarcity.
- Most physical commodities have *marginal costs of production that fall* as the system scales in its ability to extract it, because as more capital is invested in the process of production, economies of scale are achieved and incrementally more units are produced. Bitcoin and its proof-of-work peers have *marginal costs of production that rise* as more people work to "mine it," because while more resources are contributed to mining, the rate of supply production of new BTC stays fixed. Furthermore, when bitcoin's annual rate of supply production halves every 210,000 blocks, if the size of the network stays fixed, then at time of halving the marginal cost of producing each BTC doubles. This phenomenon provides one avenue for explaining why the years post-halving seem to be crypto's strongest bull markets (2013, 2017).

Store of Value (SoV) Assets

The values of pure SoV assets are notoriously capricious as they are dictated by the whims of man, with no underlying models to justify the movements. For that reason, I've hardly addressed them here, but should note that it makes the SoV component of a C/T + SoV particularly hard to assess. For bitcoin's SoV potential, we often look at the percent share of the gold market it could take, but even gold's market capitalization is a moving target. Furthermore, these assets are great reflexive instruments that demonstrate the impact of fiat supply inflation, and hence their capacity to store value should continue to grow as nations continue to inflate their fiat supplies.

Conclusion

The most common pushback I get to the above models is that they sound too complicated. That's fair, but having built models to value companies such as RedHat or Salesforce, I don't think the final form of valuing cryptoassets—be it cryptocapital or a cryptocommodity—will be more complex.

Existing models to value public companies are highly stylized beasts that have taken decades for market analysts to converge upon. They only now appear obvious because they've been used for so long. In reality, it wasn't until *Security Analysis* was published by Graham and Dodd in 1934 that we entered the modern era of stock valuation, over 300 years after the creation of equities as an asset class.

Bitcoin's barely 10 years old, "crypto" is even younger, and so it's no surprise we have a way to go in iterating upon our valuation and pricing models. In time, I expect similar convergence on standard valuation models to happen around popular cryptoassets until we get to the point where we have consensus mathematical models[8] and merely bicker over the inputs to the models, as currently happens with the rest of the capital markets. We will get there an order of magnitude faster than equities did.

My hope is that in elucidating these differences in value capture and quantification, cryptofolk stop thinking everything is zero-sum, which should lead to less bickering, more building, and better analysis. We are going to see massive heterogeneity in the types of cryptoassets that are created, with permutations falling across all three superclasses of assets. This is the land of programmable value, after all, and it is going to take share from the entire existing world of value, while also expanding (and maybe even redefining) it.

[8]One area that has promise but I'm in over my head is playing with Black-Scholes in the context of crypto. Conversing with people more versed than myself in options pricing—and seeing the parallels to cryptocommodities that are "calls on utility" (but with no expiration date…)—has always felt fruitful and exciting. The best articulation to this end has come from Johnny Antos and Reuben McCreanor: https://medium.com/blockchain-advisory-group/an-efficient-markets-valuation-framework-for-cryptoassets-using-black-scholes-option-theory-a6a8a480e18a