Ramifi: *An Improved Synthetic Commodity*

November 11th, 2020

Abstract

Synthetic commodities are a recent type of digital asset with many unique applications. They have proven to be robust and uncorrelated with existing financial instruments. As such, there are many latent potential uses for synthetic commodities in terms of value attribution. Ramifi takes a unique approach to synthetic commodity value attribution by utilizing a dynamically weighted basket of commodities to discern the dollar's purchasing power. This approach accurately accounts for inflation in real-time and allows users to better understand their underlying assets' real purchasing power.

1 Introduction

Commodities are defined as physical goods with economic value, such as gold, corn, or crude oil. These commodities have intrinsic value in society and often serve as the core building blocks for our global economy. Commodities vary in liquidity and often use derivative instruments as forward pricing mechanisms to achieve a more significant price stability level.

This asset class has absolute scarcity, meaning there exists a limited amount at any given time. It is possible to mine more gold or grow additional corn, but this process takes time, and the asset remains scarce due to its immediate limited supply. Commodities also have nonmonetary use – corn can be eaten, oil processed, and gold minted. The additional nonmonetary uses make commodities an imperfect tool for backing money (Goodspeed 2018).

The advent of the internet and near-instant digital communications has allowed for the development of synthetic commodities, which exist entirely in digital form (Selgin 2015). These assets have absolute scarcity but no nonmonetary value. Their lack of physical representation means that they have no secondary use care impacting how they are priced. This sole use case, in turn, makes them more viable candidates for use in monetary backing and financial instruments.

		Non-Monetary Use	
		Yes	No
Absolute Scarcity	Yes	Commodity	Synthetic Commodity
	No	Coase Durable	Fiat

Figure 1.1

Absolute scarcity and non-monetary use are the two primary factors when considering how to back a monetary supply using a secondary asset (Goodspeed 2018).

The significance of this recent development is striking – starting with Bitcoin's development, an entirely new alternative asset class has arisen. Synthetic commodities are uncorrelated with other market instruments such as stocks, bonds, and physical commodities. Nonetheless, synthetic commodities remain positively correlated with one another (Liu & Tsyvinski 2018).

The absolute scarcity and lack of nonmonetary value have led to significant volatility in the synthetic commodity asset class, partly due to their recent invention and partly due to the increasing capital inflows to the asset class. Volatility naturally invites speculation on future value, and thus Bitcoin has evolved in recent years into a store of value rather than a monetary instrument. There exists a significant demand for synthetic assets that allow for both speculation, as is the case with Bitcoin, yet remain relatively constant in price.

Ramifi is an improved synthetic commodity that seeks to facilitate relative price stability while also accommodating the fluctuating capital inflows associated with this new asset class. The protocol accomplishes this using dynamic supply adjustments that account for the elastic demand associated with

synthetic commodities. Adjustments are periodic and are weighted relative to a basket of commodities. The relatively stable value allows for more optimal price discovery between synthetic commodities and existing monetary regimes. As fiat currencies' purchasing power continues to erode, real-time data regarding purchasing power and investment returns of synthetic commodities will continue to increase in importance. Ramifi provides a straightforward solution to this demand.

2 Inflation

Inflation is a persistent force in any monetary system. Inflation can be generally conceptualized in the following way: when economic expansion outpaces the rate of inflation, the purchasing power of the currency rises – when inflation outpaces the rate of economic growth, the purchasing power of the currency falls. Regardless of what backing a currency has, inflation must be accounted for as accurately as possible to discern money's actual purchase power. As the world economy increases in nuance, the need for accurate metrics on purchasing power and inflation becomes ever more vital.

This importance is true for both hard monetary systems and fiat currency regimes. A hard monetary system is backed by a scarce commodity, such as gold, and leverages this commodities scarcity to support its value. Historically all hard monetary systems have been backed by physical commodities, the most popular being gold. While a future currency may elect to utilize a synthetic commodity such as Bitcoin to support its monetary system, humanity has yet to see such a development.

In contrast to this backing by a scarce resource, fiat currency systems' purchasing power is backed by the issuer's full faith and credit (Ferguson 2008). Faith and credit are intangible and non-scare, thus allowing for more flexible fiscal and monetary policies. While flexible monetary policy is beneficial for central planners, checks and balances must be in place to assure that currency issuance does not outstrip the rate of inflation by a large margin. In 1971 the US dollar transitioned from a hard monetary system to a fiat currency system. This transition resulted in a significant shift for the US dollar's inflation rate and its calculation, resulting in the absolute purchasing power of the currency decreasing and the overall supply of currency increasing drastically.

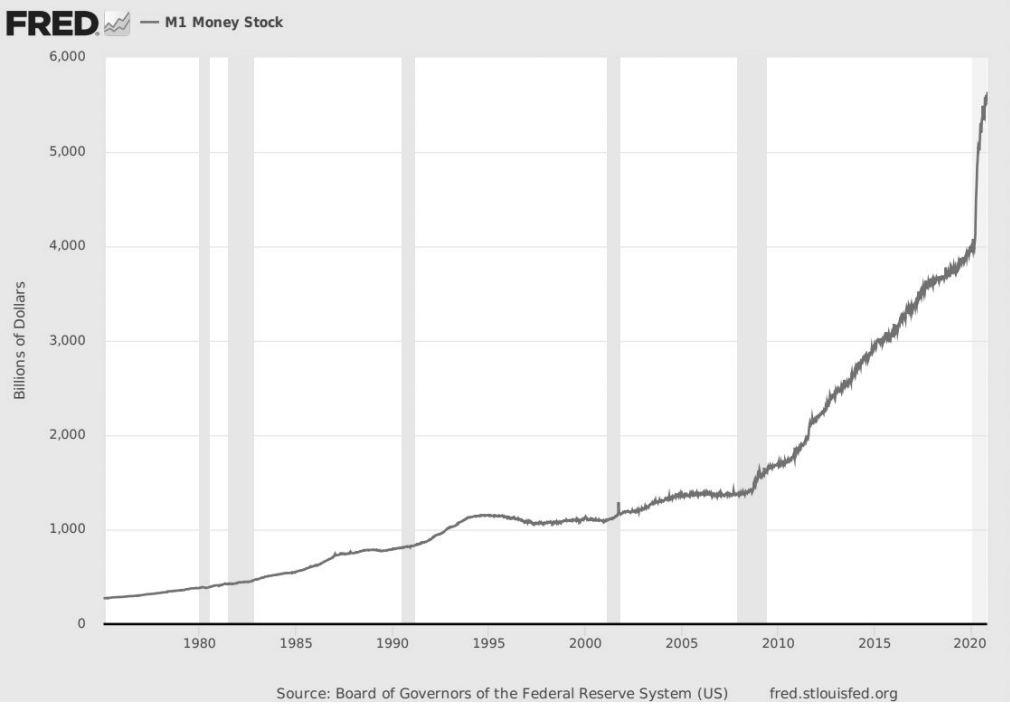

Figure 2.1

The available money supply has continued to increase at a rapid pact since the great financial crisis of 2008. This increasing rate highlights the disconnect between the rates of expansion in the money supply and increases in economic activity. Image Source

Both hard monetary and fiat currency regimes experience inflation, albeit at different rates. Historically, gold was the commodity of choice for backing money. The rate at which gold is mined roughly correlates with the global economy's expansion – approximately 2% per year. For this reason, gold was the best solution for monetary backing in the 19th century but has become increasingly antiquated as technology has evolved. As previously mentioned, the non-monetary value of money, its physically cumbersome form, and asymmetrical gold deposits worldwide make the commodity an increasingly poor candidate for monetary backing.

Following the Second World War, there arose a dire need for a more globalized monetary system to avoid the intense cycles of economic booms and busts while rebuilding the global economy. This need resulted in the Bretton-Woods system in which the US dollar was chosen as the world's reserve currency and pegged to the price of gold at $35 per ounce. While still utilizing gold for relative stability, the global monetary system began to rely more on dollars. The liquid nature of dollars enabled a swift economic recovery and demonstrated greater robustness than the previously heterogeneous monetary regimes. Gold was falling out of favor as a monetary backing and began experiencing elevated dollar-denominated price volatility levels.

The United States abandoned the gold standard in 1971, and the dollar became a full fiat currency. This transition allowed for massive economic expansion at the cost of the dollar's overall consumer purchasing power. While this had stunningly positive consequences for the average global citizen in the short term, these positive developments are threatened by the erosion of the dollar's purchasing power. The US dollar

has [lost over 84% of its purchasing power] since 1971 and continues to erode at an accelerating rate, threatening future economic progress.

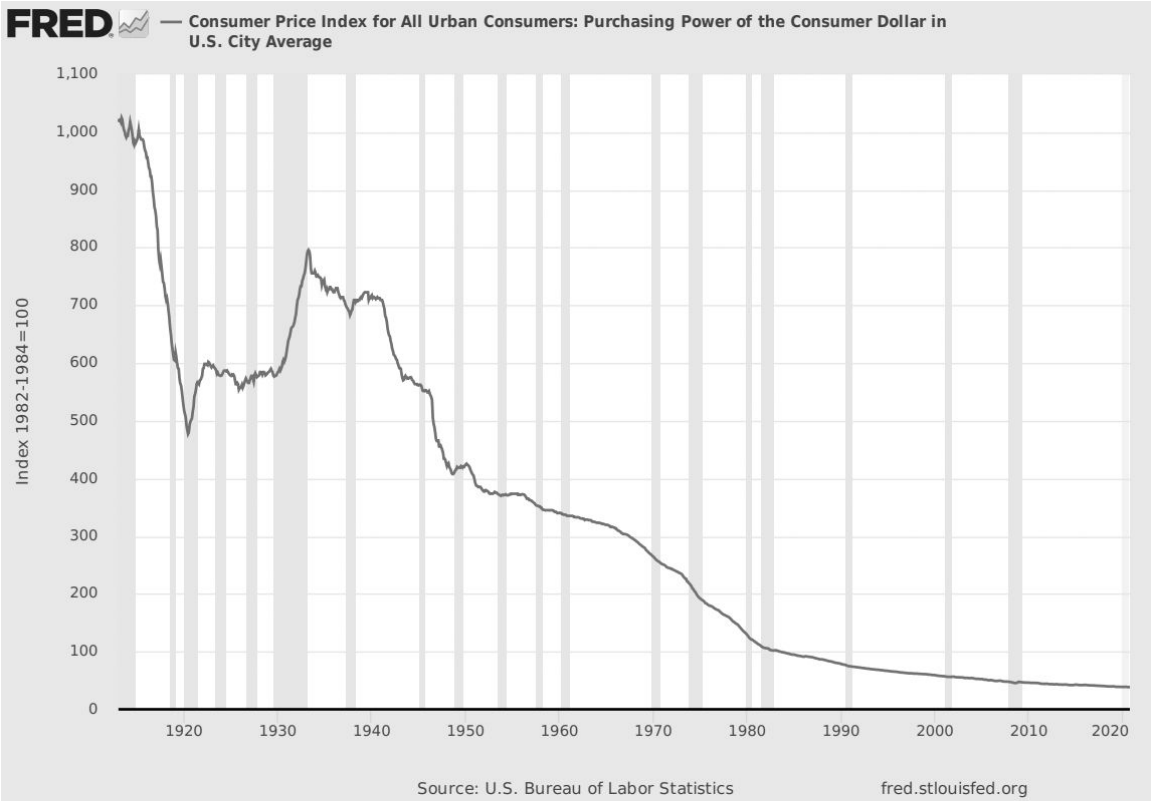

Figure 2.2

The real purchasing power of the US dollar has rapidly decreased since the 1920s, losing over 84% of its purchasing power. Fiscal stimulus is experiencing increasingly diminishing returns. [Image Source]

There is a dire need to accurately track the rate of inflation and clarify the role of synthetic commodities in future global monetary policy. The question of how long the US dollar can persist as the world's reserve currency is a hotly contested topic. While there is speculation as to what currency may replace the US dollar, no fiat alternative serves as a viable candidate. The role of synthetic commodities will invariably play an increasingly important role in global monetary policy and backing.

3 Dollar Denominated Synthetic Commodities

3.1 Tether

Tether was the first successful project that sought to connect the value of the US dollar to the new alternative asset class of synthetic commodities. The nominal rate of Tether is pegged to the dollar through the issuance and destruction of existing Tether tokens. While initially claiming to be fully backed by US dollars held in an escrow account, Tether now admits that its dollar peg is artificially maintained.

While historically stable, this synthetic commodity has seen rampant speculation regarding its origins and future. Tether issuances' opaque nature exposes the synthetic commodity to potential fraud while subjecting users to credit and business risk of the issuer.

3.2 Maker Dao

In terms of distributed governance, Maker Dao was the first synthetic commodity to launch a soft pegged token to the US dollar. Other synthetic commodities such as Bitcoin and Ethereum are staked as collateral in the Maker ecosystem. The distributed algorithm then utilizes risk parameter analysis to establish interest rates on subsequent loans against these assets. This process establishes a collateralized debt position, also referred to as a CDP. On top of the established interest rate, CDPs are collectively used as collateral to maintain Dai's stable peg to the dollar. Supply is dynamically adjusted relative to demand, with these fluctuations being reflected in the cost of loans against CDP positions. This innovative approach decentralized the mechanisms that control the stablecoin's supply but expose holders to credit risk within the ecosystem as the stable rate is predicated on an ecosystem of collateralized loans.

3.3 Ampleforth

Improving upon the concept of a synthetic commodity pegged to the dollar, Ampleforth has made great strides in tracking dollar value and demand using decentralized financial applications. Independent of credit risks associated with loan ecosystems, the Ampleforth token's sole purpose is to provide a stable dollar peg that dynamically adjusts relative to user demand. The impact of the fluctuating supply of dollar-pegged tokens is passed directly to the user, thereby allowing for a stable nominal rate while accounting for user demand in a more flexible manner. In the event of elevated demand, in which the price of one Ampleforth token will increase, the US dollar peg is enforced via distribution to users. Conversely, if demand declines and one Ampleforth token's price falls below one dollar, the total supply of tokens is decreased. This process impacts all token holders uniformly, assuring that proportional token ownership remains constant in the event of token recalibration. Additionally, this allows users of Ampleforth tokens to benefit from increased demand for tokens over time as their supply of tokens will increase proportionally to total demand. This process's results are desirably straightforward – rather than a fixed supply in which the nominal value of the asset fluctuating relative to demand, there is a fixed nominal value in which supply fluctuated relative to demand.

3.4 Ramifi

Ramifi improves the mechanism established by the Ample protocol markedly. The Ramifi protocol discerns the dollar's actual purchasing power in the world economy and dynamically adjusts supply accordingly. Rather than accepting the dollar's nominal value at face value, Ramifi accounts for real-time dollar inflation by tracking a basket of dynamically weighted commodities. This tracking mechanism allows individuals to calculate the real rate of inflation, accurately track their returns on an investment relative to inflation and paves the way for a more seamless transition towards a future of decentralized financial applications and synthetic commodities.

4 The Ramifi Protocol

The Ramifi protocol's unique approach to the dollar's declining real purchasing power is critically important due to increasing inflation. Currently, consumer inflation is calculated using a metric known as the Consumer Price Index. Over time, this index's approach to calculating consumer inflation has changed drastically, having consistently been adjusted to demonstrate low inflation rates. The results of these miscalculations have been starting – rather than the nominal consumer inflation rate of roughly 1.4%, the actual rate of consumer inflation is likely somewhere around 10%. This large discrepancy helps to explain the increasing dissatisfaction of the average consumer as their currency's purchasing power continues to erode.

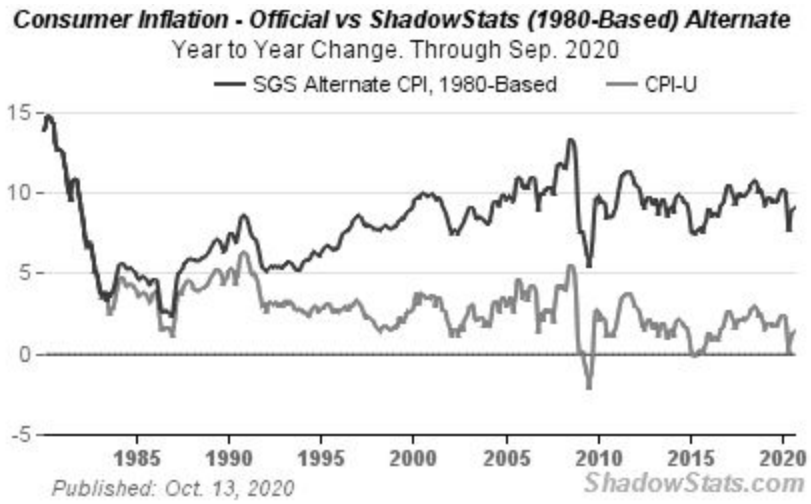

Figure 3.1

The Consumer Price Index (CPI) is utilized by the US government to calculate the rate of consumer inflation. Due to systematic adjustments to how the CPI is calculated, the CPI has grown into an increasingly inaccurate measurement of real consumer inflation. Image Source

Due to the miscalculated rate of inflation and the velocity of devaluation, Ramifi addresses the clear demand for a durable synthetic commodity that accurately tracks the world's largest fiat currency's real purchasing power. As digitization continues to occur rapidly, we believe that users will become increasingly aware of the rapidly declining purchasing power of their assets. For these reasons, the supply of Ram tokens will be continually adjusted at set intervals to reflect both fluctuating user demand as well as real-time changes to the purchasing power of the US dollar relative to a basket of dynamically weighted commodities.

Ramifi utilizes blockchain technology to enforce protocol rules and assure a stable peg to the real inflation-adjusted dollar is maintained. The distributed nature of the protocol assures that no centralized actors can collude for their benefit at the network's expense. Blockchain technology also enables Ramifi to be a synthetic commodity by increasing the digital good's durability, shielding it from individual business or credit risk.

Dynamic supply adjustments are also more easily handled using blockchain technology. The periodic checkpoints associated with blockchain allow for definitive points at which the market oracle provides data to the supply contract. Additionally, this process is fully transparent and can be audited from any outside actor using the Ethereum network.

The growing interconnected ecosystem of decentralized finance, or defi, is empowering users to make informed decisions about utilizing their assets. As distributed systems continue to evolve as the dollar declines' purchasing power, the Ramifi protocol will serve as the interface for reliably tracking these trends.

5 Balancing Algorithm

The Ramifi algorithm seeks to achieve what it terms a *price-supply* equilibrium, in which two simple rules are followed. If Ram trades above the target nominal exchange rate, then supply is increased and distributed to shareholders. If Ram trades below the target's nominal exchange rate, then the supply is decreased, and the shareholder stake diminishes proportionally.

This balancing algorithm takes hyperbolic price movements into account by distributing tokens in proportion to Ram tokens' velocity of upward and downward price movement. It is important to note that Ram's price is always targeted at one inflation-adjusted US dollar in either event. Rather than the nominal rate, or price, of each Ample fluctuating, as is the case with other synthetic commodities such as Bitcoin, it is the underlying *supply* that fluctuates for Ram to maintain a stable dollar peg.

Synthetic commodities have demonstrated greater demand elasticity than traditional asset classes. This elasticity is partly due to the recent nature of their creation, which results in comparatively low volumes relative to more established asset classes. Additionally, the entirely digital nature of synthetic commodities allows for near-instant transaction times in an environment absent of central market controls in traditional markets. Therefore, considerations regarding supply smoothing must be undertaken to avoid overcorrections that would inevitably result from period adjustments during times of high demand elasticity. Supply changes are actualized over a set period to avoid sudden and unnecessary instability in price. For example, if the price fluctuates to 1.5 RAM: 1 USD, a supply *increase* of 50% will occur uniformly over X number of days. Conversely, if the price fluctuates to 0.5 RAM: 1 USD, a supply *decrease* will occur uniformly over X number of days.

5.1 Expansion, Contraction, and Equilibrium

In an expansion, the supply of Ram will increase over the distribution period calculated by the market oracle. Rational actors will see this opportunity to sell Ram at a higher price before the supply actualizes and reinforces the supply adjustment.

In a contraction, the supply of Ram will decrease over the distribution period calculated by the market oracle. This period presents to rational actors' the opportunity to acquire more Ram at a lower market price as the supply subsequently adjusts over the set period.

Equilibrium is projected to be finite periods in the Ramifi protocol, punctuated by period adjustments of expansion and contraction. In equilibrium events, the supply remains unchanged and rational actors are presented with no immediate price arbitrage opportunity.

These three states allow for the overall market cap of Ram to increase over time while assuring that the inflation-adjusted peg to the dollar remains intact.

5.2 Ramifi's Contributions

Intaking real-time information regarding asset prices requires data arbitration. For this purpose, the Ramifi protocol utilizes a market oracle comprised of independent data providers. These providers are aggregated and weighted against one another relative to transaction volume, thereby allowing the most liquid market makers to impact price finality significantly. Some commodities experience more significant fluctuations relative to the US dollar.

These fluctuations are accounted for by weighing their market cap, total volume, and other key metrics to ascertain the most accurate picture of the dollar's purchasing power. Additional market oracle parameters will account for high sigma events that might result in a bias interpretation of inflation-adjusted purchasing power.

The initial adjustment schedule will calculate every 24 hours and is actualized over a set period of 30 days. This approach allows for dynamic supply adjustments while avoiding large and sudden shifts in available supply. In the event of an outlier price event submitted to the market oracle, the Ramifi protocol will weigh the calculation in such a way to prevent disproportionate adjustments. For example, the price of oil futures contracts plunged into negative territory before subsequently adjusting to a more normal range in 2020. These sudden and unexpected price events that are quickly recovered from will be programmatically accounted for to avoid large changes in Ram price that are subsequently corrected when the underlying commodity returns to more reasonable price levels.

By adjusting supply in response to demand, the Ramifi protocol utilizes countercyclical pressure to maintain price equilibrium. How supply adjusts will likely lead to market action distinct from existing synthetic commodities in which there are a relatively fixed supply and dynamic price. For this reason, a volatility fingerprint is used to track supply trends that result from periodic adjustments.

As the market cap of the Ramifi protocol increases, there will be correlations between periodic adjustments and states of disequilibrium as the protocol enforces the US dollar peg. Subsequently, these disequilibrium periods will result in a price curve that trades relative to the exchange rate target as secondary markets seek to profit from periodic adjustments. In this way, rational actions work in synchronicity with the Ramifi protocol's period adjustments to maintain the inflation-adjusted dollar peg.

Rational actors that act quickly have a window of opportunity to take advantage of supply adjustment periods, in which the price correction has not yet occurred. In the event of supply expansion, actors can sell their shares before the price reaches equilibrium. In the event of a supply contraction, actors can buy additional shares at a discount during the period of disequilibrium. With secondary market actors working in conjunction with periodic algorithmic adjustments, a financial incentive mechanism exists to reinforce Ram's dollar peg during periods of disequilibrium.

6 Denominated Mean Calculation

The pricing of commodities occurs using a system called futures contracts. To ensure that a given commodity's price is locked in at a set date, producers utilize the good buy contracts that guarantee delivery of the commodity on a specified date and a specified price. These futures contracts assist producers in accounting for price variations and ease financial accounting burden while utilizing a commodity that experiences daily price fluctuations. For example, a tortilla manufacturer might purchase a corn futures contract to lock in the price they will be paying to deliver that commodity. This stability protects both the company from a potential spike in corn prices and the commodity producer from the difficulties associated with finding a last-minute buyer.

Futures contracts are incredibly liquid thanks to a robust secondary market in which speculators actively trade contracts before their expiration dates. This liquidity reinforces the underlying commodity price and facilitates an efficient method of price discovery for an otherwise cumbersome physical asset class. It is important to note that unlike options, futures come with the obligation that the contract holder take delivery of the underlying commodity at the contract's expiry date. For this reason, the time value of commodity futures contracts is a highly salient feature of the contract. As such, commodity futures contracts that are closer to their expiration date generally trade with less volatility than contracts that expire closer to the given date.

The Ramifi Market Oracle tracks over 150 of the global market's most liquid commodities to assure that it represents the most accurate picture of inflation weighted US dollar purchasing power as possible. Illustrating this fact, the commodities that experience the most trading volume are more heavily weighted in by the oracle. For example, there are over 2 million open interest contracts of WTI, the world's most liquid crude oil futures contract sponsored by the Chicago Mercantile Exchange (CME), representing over $80 billion of speculative capital currently invested in crude oil.

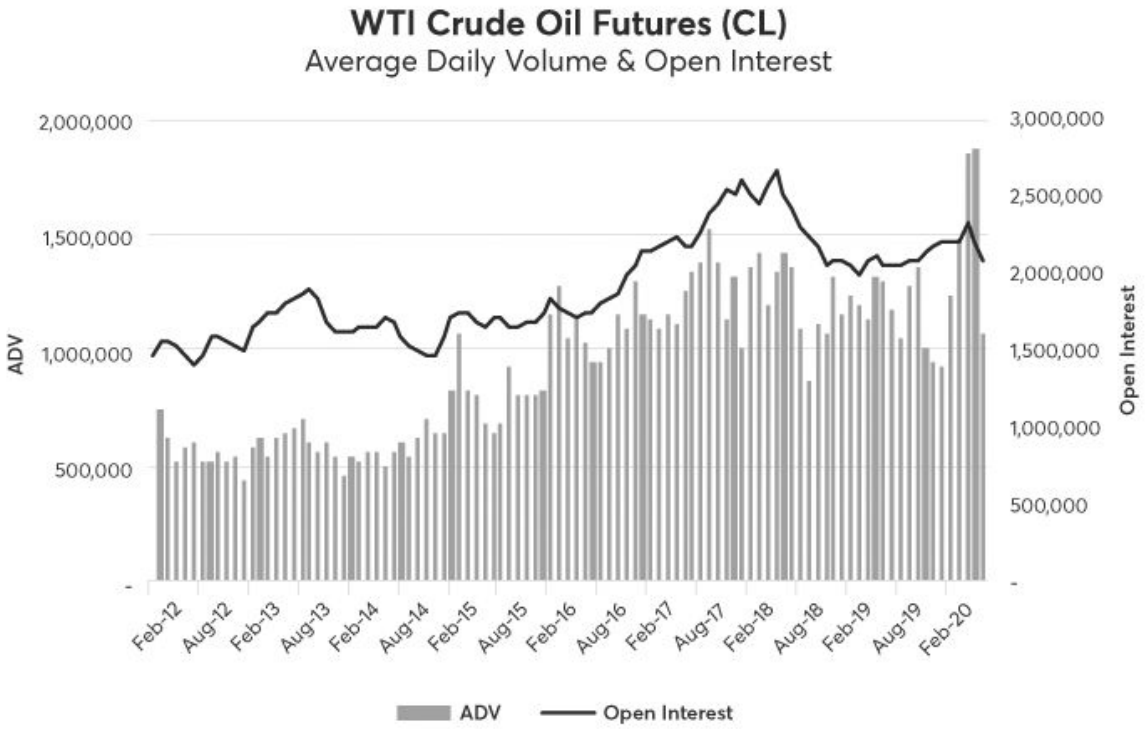

Figure 6.1

As the primary fuel source for our modern world, oil is the most liquid commodity traded today. Open interest oil contracts measure in the tens of billions of dollars at any given time. Image Source

Crude oil is the most heavily traded community in the world by volume. The place of oil in the global economy is hard to overstate – it not only powers the technology that drives international trade but partially backed the world's reserve currency for several decades under a regime known as the petro-dollar. For this reason, Ramifi's approach to an inflation weighted dollar fixed to a volume-weighted index of commodities is new but echoes a historically proven approach.

Corn is the second most traded commodity globally, helping to feed the world's growing population. With a compound annual growth rate of 5.3%, the global market share of corn is set to outpace the US dollar's CPI by roughly three-fold. This preliminary data suggests that the dollar's purchasing power relative to corn will increase in the coming years. However, the miscalculation inherent to the CPI demonstrates the dire need for cross-correlation analysis. Ramifi's approach accomplishes this and will serve as a benchmark for discerning the real rate of dollar inflation and can be utilized as a reference tool against reweighted averages that attempt to gauge consumer inflation more accurately.

Gold, despite its removal as the commodity of choice backing monetary supplies of various currencies, remains one of the most liquid commodities traded with futures contracts. It is a durable metal regularly used in electronics manufacturing. This commodity is also viewed as a store of value by individuals who remain skeptical of fiat currencies' consistent purchasing power. COMEX, one of the world's most popular exchanges trading gold futures contracts, has experienced record demand for physical delivery in the wake of the Covid-19 pandemic. The subsequent massive fiscal stimulus resulted in a heavily increased demand for physical possession of the precious metal, demonstrating the growing wariness surrounding the dollar's durable purchasing power and other currencies.

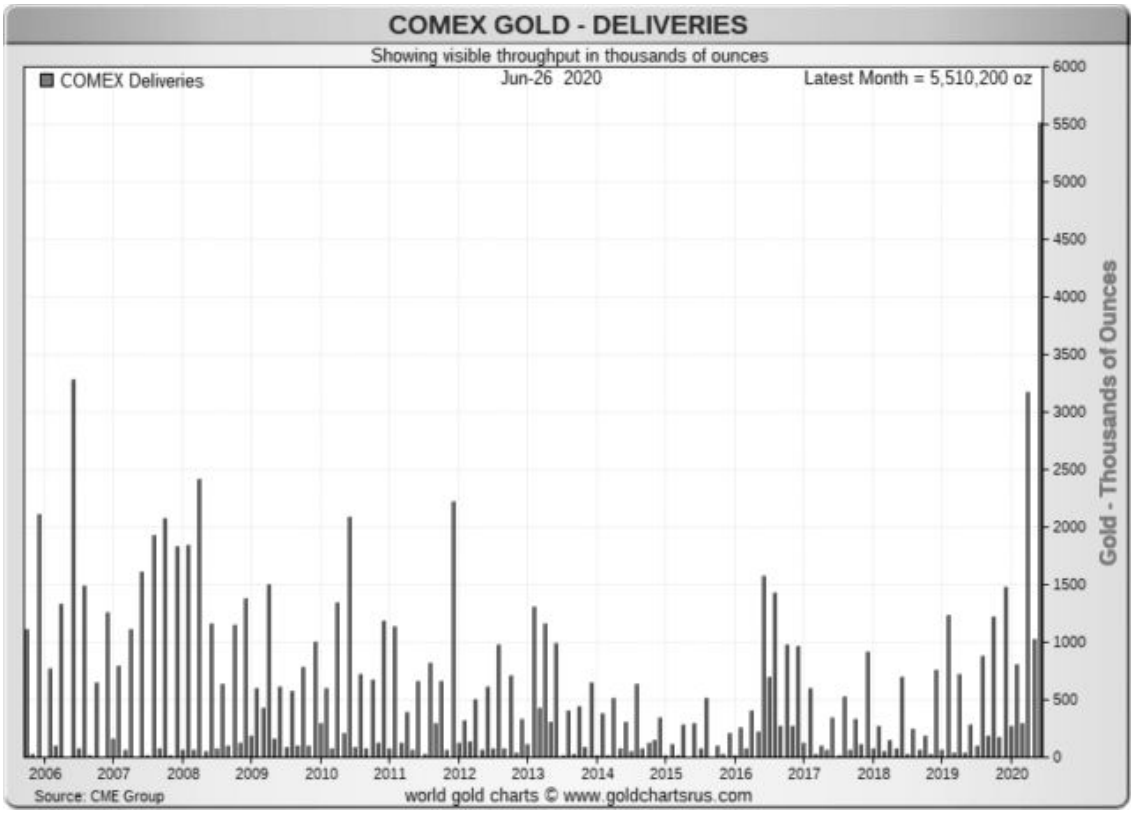

Figure 6.2

Demand for physical delivery of gold has skyrocketed in 2020, highlighting growing fears surrounding the long term stability of fiat regimes around the world.

Ramifi employs the world's top commodity futures contract exchanges and analyst companies to deliver a proprietary data feed to the market oracle. This diversity in information assures that the supply adjustment schedule is as accurate as possible, tracking the dollar's fluctuating purchasing power. Some of the exchanges and firms used to track real-time commodity price data accurately include:

- Chicago Mercantile Exchange
- Intercontinental Exchange
- Open Data for Africa
- Johnson Matthey
- London Bullion Markets Association
- London Metals Exchange
- Organization of the Petroleum Exporting Countries
- World Bank

Some of the calculations that the Ramifi protocol uses to discern the value of futures contracts include:

- Fertilizers Index
- Food Index
- Timber Index
- Metals and minerals Index
- Beverages Index
- Energy Index
- Non-energy commodities Index
- Fats and oils Index
- Agriculture Index
- Grains Index
- Raw materials Index
- Other raw materials Index
- Misc. food Indexes

Let's take a look at an example calculation,

> 1 RAM is equal to 1 USD based on a 2020 USDs purchasing power. We accomplish this by looking at what 1 USD can purchase today in terms of major commodities across the globe and averaging them all together weighted by volume.

Let's take a look at corn which is denominated in *bushels*,

$$1\ Bushel = 115.21 USD$$
$$1\ RAM = 1/115.21$$
$$= 0.008679\ Bushels\ (pC1)$$

This is then averaged against other commodities weighted by its global trade volume. So lets add another commodity gold which is denominated in troy ounces and goes for $1,951.50/troy ounce.

$$1\ RAM = 1/1951.50$$
$$= 0.000512426\ toz\ (pG1)$$

Now if the price of corn went up 2% and the price of gold went up 5% the new RAM value would be an average of the two weighted by their daily volume.

> *Corn's new price would be* 1/117.5142 = 0.008509 (*pC*2) *with a daily volume of* 439,357 (*vC*) *at* 117.5142/*bushel* (*pC*2).

If we stopped here 1 RAM would now equal 1.02 USD because (0.008679/0.008509 = 1.02).

We aren't basing this on a single commodity. Additionally, gold's new price would be:

1/2049.075 = 0.00049 (*pG*2), *with a daily volume of* 234,363 (*vG*) *at* **2049.075/*toz* (*pG*2)**.

((*pC*1/*pC*2) ∗ (*vC*∗*pC*2) + (*pG*1/*pG*2) ∗ (*vG*∗*pG*2)) / ((*vC*∗*pC*2) + (*vG*∗*pG*2)) ((*pC*1/*pC*2) * (*vC* * *pC*2) + (*pG*1/*pG*2) * (*vG* * *pG*2)) / ((*vC* * *pC*2) + (*vG* * *pG*2)) ((*pC*1/*pC*2) ∗ (*vC*∗*pC*2) + (*pG*1/*pG*2) ∗ (*vG*∗*pG*2)) / ((*vC*∗*pC*2) + (*vG*∗*pG*2)) =

This equation gives us RAM's new USD value being: **1.0471**

7 Conclusion

Synthetic commodities that track real-world values are already playing a vital role in the growing world of decentralized finance. Discerning the dollar's real rate of inflation allows us to price goods and services more accurately in the global economy. Ramifi accomplishes this by using a denominated mean that is calculated from over 150 commodities. Ramifi is dynamically weighted using transaction volumes and reflects the real purchasing power of the dollar.

This insight is becoming increasingly valuable as fiat currencies' purchasing power continues to erode at an accelerating pace over time. For these reasons, Ramifi will play a central role in discerning the dollar's real purchasing power.

References

[1] Ferguson, N. (2008). The Ascent of Money: A Financial History of the World. Penguin.

[2] Goodspeed, T. (2018). "Kicking Away the Ladder? Cryptocurrencies in Historical Perspective." Applied History Volume (Working Paper).

[3] Kue, E. Iles, B, and Cruz, M. (2019). "Ampleforth: *A New Synthetic Commodity*." Ampleforth Whitepaper available at: https://www.ampleforth.org/papers/

[4] Liu, Y., and Tsyvinski, A. (2018). "Risk and Returns of Cryptocurrency." National Bureau of Economic Research (Working Paper).

[5] Nakamoto, S. (2009). "Bitcoin: A Peer-to-Peer Electronic Cash System." Bitcoin White Paper available at: https://bitcoin.org/bitcoin.pdf

[6] Selgin, G. (2015). "Synthetic Commodity Money." Journal of Financial Stability.

[7] Wood, G. (2014). "Ethereum: A secure decentralised generalised transaction ledger." Ethereum Yellow Paper available at: http://gavwood.com/paper.pdf.

Appendices

1 Software Architecture

The Ramifi protocol is built on the Ethereum blockchain and maintains several touchpoints both within and outside the network. Outside of the Ethereum network, there are two primary participants in the protocol. The first of these external touchpoints is that of data providers. These third-party entities provide real-time market data parsed by the Ramifi market oracle and subsequently synthesized into the inflation-adjusted rate. The second external touchpoint category includes rational actors that exist in the form of secondary market participants. This groups' buying and selling of Ram tokens assist in maintaining the inflation-adjusted dollar peg.

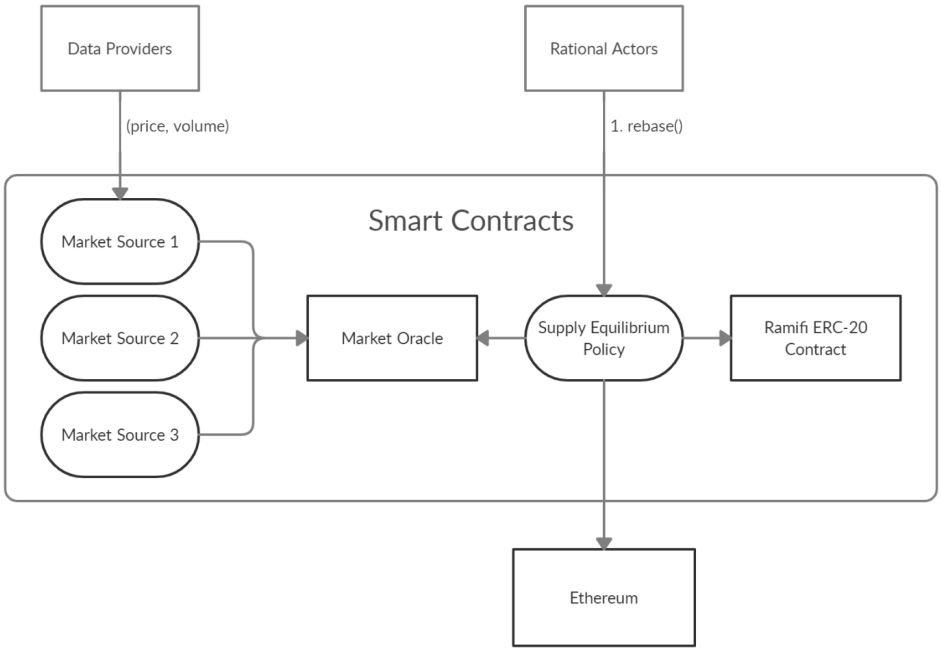

Figure A.1

The Ramifi protocol employs a number of external data sources which are dynamically weighted using the market oracle. This weighted information is used to calculate supply adjustments relative to the supply adjustment policy portion of the Ramifi smart contract.

The Ramifi protocol utilizes the standard ERC-20 contract code. Additionally, it employs Ampleforth's addition of the *rebase(uint256 epoch, int256 supplyDelta)* function. This function instructs the contract holder to adjust the total supply and is callable by the *Supply Policy Contract*.

If *supplyDelta* is positive, existing holders are issued additional tokens that are created. If *supplyDelta* is negative, existing holders have a portion of their existing tokens removed.

Executing individual transactions on the Ethereum blockchain for each supply adjustment would prove prohibitive. The Ramifi protocol adjusts balances internally using hidden internal denominations to circumvent this erroneous cost.

The hidden internal denomination and the external denominations are controlled by an exchange rate equal to *hiddenSupply/uFragmentSupply*, which results in the real conversion rate between the two.

Achieving numerical stability in rounding presents a difficulty as the Solidity language does not support floating-point numbers. Therefore, when rounding, the Ramifi protocol follows a stricter version of the EU's currency conversion calculations guidelines.

Conventional currency conversion systems allow for a miniscule amount of transactional discrepancy due to real-time conversion calculations' unavoidable nature. As in any conversional function *f* with a non-zero rounding error, *f(x0)+f(x1)+...+f(xn) is not always equal to f(x0 + x1 + ... xn).*

2 Supply Policy

The contract that dictates the Supply Policy uses the *rebase()* external function, but it is distinct from the identically named Ramifi ERC-20 *rebase()* function. Instead, it is a function that can be called by anyone and executes roughly every 24 hours. This function's openly callable nature allows rational market actors to react to supply adjustments independent of the core Ramifi team.

The Market Oracle is first called to establish a current inflation-adjusted price of the dollar. If the oracle finds that the price is within the *priceTheshold* of the target, then no subsequent adjustments are made to Ram's supply. Conversely, if the *supplyDelta* is equal to *(price-target*totalSupply/target*), an adjustment occurs proportional to the price difference – for example. Suppose the price of inflation-adjusted dollars is calculated to be $1.10. In that case, a supply addition of 10% is created to account for the price discrepancy and return the base price to equilibrium.

As mentioned, this process does not execute immediately but instead utilizes a time lag to assure a smooth return to equilibrium. The base time frame for this process is set for 30 days at the launch of the platform. Taken in conjunction with the above calculation, a 10% supply increase over a period of 30 days would result in (10%/30days) = 0.3.33% per day.

Due to the asymmetrical nature of transactions on a blockchain, supply policy calculations will occur slightly more than 24 hours apart from one another. The Ampleforth protocol has calculated a variation of roughly one hour per year in their supply adjustment calculations. The Ramifi team is undertaking tests to account for this variation. One such approach includes a "bonus" calculation every 24 years; however, due to the significant time horizon associated with this procedure, any solution remains in the realm of speculation at the time of writing.

3 Market Oracle Contract

The Ramifi market oracle draws data from a wide range of outside sources and interfaces with the Supply Policy contract. At each 24 hours calculation period, the supply dynamically adjusts relative to the

inflation-adjusted dollar value. Only whitelisted sources can provide data to the market oracle at launch. The data used to calculate period adjustments will be weighted for high sigma events that would otherwise skew the dollar's inflation-adjusted value, thereby preserving the accuracy of the Ramifi protocols calculations.

Acknowledgments

We would like to offer our sincerest gratitude to the Ampleforth team for their contributions to the field of synthetic commodities. Without their contributions the Ramifi project would not be possible. We look forward to building a robust ecosystem of synthetic commodities and digital assets for years to come.

". . . If I have seen a little further it is by standing on the shoulders of giants."

- *Isaac Newton*