Smoothing the Bitcoin ride: Long-term appreciation with a limited downside risk

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Virtual currencies such as Bitcoin and Ethereum constitute a relatively novel asset class that enjoyed significant appreciation over the past several years. However, global accessibility and low entry barriers resulted in an ongoing sequence of booms and busts along their price trajectories, rooted in irrational exuberance and herding behaviour of the trading crowd. The development of speculative bubbles and subsequent corrections is significantly accelerated in the case of virtual currencies as compared to more traditional asset classes such as equities, fiat currencies, and commodities. This translates into investor fear of losing a noticeable portion of their holdings while waiting for potential rallies. Here we propose an algorithmic hedging strategy for Bitcoin, the leading virtual currency asset, which implements a dynamically modulated exposure responding to the market state. Our strategy is based on crowd behaviour analysis rooted in the physics of complex systems, and is designed to capture a large portion of the long-term asset appreciation with reduced volatility. We anticipate the improved risk-adjusted performance to generate a significant global interest in the Hedged Bitcoin offering from a variety of individual holders as well as institutional investors.

Figure 1: *Time evolution of (A) Bitcoin price in US Dollars, and (B) Bitcoin network hash rate. The logarithmic scale is applied to vertical axes for clarity. Insets zoom in on the most recent time period at the time of writing.*

1 Speculative aspect of Bitcoin valuation

Global accessibility of Bitcoin for individuals and institutions generates a complex, world-wide network of market participants with a strong tendency for imitation. Intrigued by dramatic rallies unprecedented in more traditional asset classes, Bitcoin buyers tend to herd along with the crowd generating unsustainable price trends. As a result of thi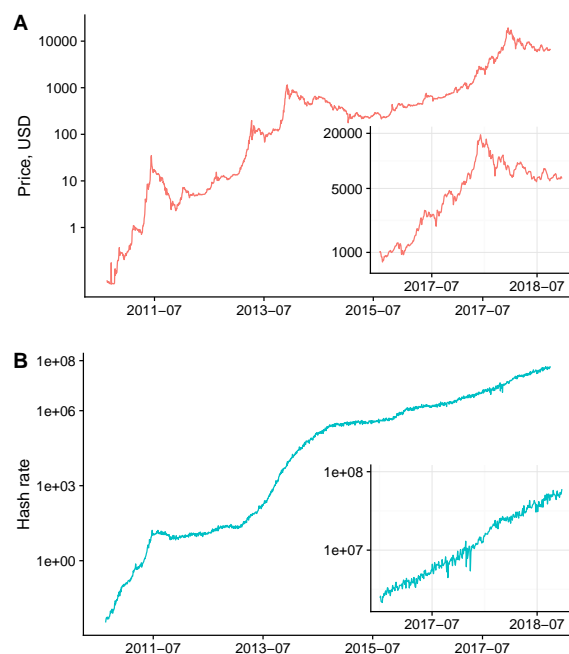s irrational exuberance [1], the dynamics of Bitcoin value reflected in exchange order books undergoes a series of bubble-like phases with subsequent bursts (dramatic price corrections).

A conversion rate of Bitcoin to US Dollars taken from dominant virtual currency exchanges over several years is presented in Figure 1. The Bitcoin network hash rate is plotted for comparison as a remote proxy of computational expenses involved in mining new coins[*]. This

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[*]Data from `https://www.blockchain.com/`, last accessed 2018-09-27.

comparison suggests that transient periods of Bitcoin price acceleration are not driven by changes in the intrinsic difficulty of producing Bitcoin. In fact, it has been shown [2] that Bitcoin price leads the mining difficulty and not the other way around, i.e. it is rising prices that attract new miners and more funding to the Bitcoin ecosystem.

While it is quite common in general for business cycles to emerge through the interplay of innovation and speculation [3], Bitcoin shows much faster replay of such cycles as compared to, e.g., the stock market. A sequence of bullish rallies terminated by dramatic price drops[†] suggests a global, macroscopic emergence of herding behaviour as the key speculative value driver of the virtual currency.

2   Market opportunity

The speculative economics of virtual currencies culminating in transient bubbles and subsequent crashes limits the adoption of Bitcoin as a buy-and-hold investment vehicle. As an illustration, representative cases of Bitcoin market corrections[‡] are listed in Table 1. It is clear that the prospect of losing over a third of one's investment in a matter of days limits the utility of Bitcoin for an average investor. It has recently been shown that on average, every 20 days one should expect a loss of about 10% [4]. Correspondingly, poor risk-adjusted performance limits institutional asset flow into virtual currencies, which could otherwise be considered as a diversifying asset class [5] with a strong upside potential.

Several alternatives to buy-and-hold Bitcoin investment have recently emerged. A number of hedge funds now offer investment into virtual currencies. Such funds however charge considerable performance fees according to the standards of more traditional financial asset managers, and typically restrict their offerings to high net worth accredited investors due to regulatory constraints. A different type of investment option potentially accessible to a wider range of individual investors is proposed by the Enigma Catalyst platform [6], which leverages blockchain technology to provide a decentralized marketplace for predictive data and virtual currency trading strategies. This new technology could, in principle, enable crowdsourcing of the investment process, but would require active management of trading strategy selection on the investor side. Performance fees paid to the de-

Table 1: *Bitcoin market correction examples. A buy-and-hold investor would experience losses corresponding to the price drop column over the correction time interval. The relative size of the crowding instability* **detected prior to each correction** *using our proprietary methodology (sec. 3.1) is listed in the last column.*

Correction			
Start Date	Duration	Price Drop	Instability size
2013-11-30	18 days	64%	51%
2014-11-13	8 days	25%	27%
2015-07-12	5 days	13%	20%
2015-11-04	7 days	39%	32%
2016-06-18	5 days	29%	27%
2017-01-05	7 days	35%	42%
2017-03-10	15 days	33%	42%
2017-06-11	35 days	39%	53%
2017-09-02	13 days	41%	82%
2017-11-08	4 days	30%	77%
2017-12-17	51 days	70%	96%

velopers of trading strategies could be another factor limiting the interest from average investors.

Another alternative is provided by several crypto-asset investment platforms such as ICONOMI[§] and Melonport[¶]. These platforms allow individuals to manage portfolios of virtual currencies and related cryptographic tokens. While a portfolio of virtual tokens can achieve a certain level of diversification of the idiosyncratic risks, it would still be susceptible to a significant systemic risk component. Therefore, such token portfolios would still suffer dramatic corrections due to the speculative nature of the entire virtual currency ecosystem.

Systematic, algorithmic hedging of virtual currencies constitutes a promising, yet unavailable alternative to currently existing investment offerings. Implemented through an easily accessible product offering, this approach could attract a wide range of individual as well as institutional investors seeking to achieve diversification [5] while harvesting virtual currency returns with reduced risks.

3   Hedged Bitcoin offering

We propose a hedging strategy for Bitcoin implemented through a portfolio of risky (Bitcoin) and nearly riskless (US Dollar) assets with dynamically managed asset weights. The primary objective of the Hedged Bitcoin offering is to achieve a balance between risk reduction and market appreciation that translates into superior

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[†]Bitcoin history also witnessed prolonged, self-accelerated bearish trends. Here we emphasize bullish rallies since their termination is associated with a more dramatic price action resulting in fast and significant investor losses. Such a market asymmetry where prices fall faster than they rise is fairly universal beyond the scope of virtual currency.

[‡]Based on the US Dollar conversion rate history on major exchanges.

[§]https://www.iconomi.net/

[¶]https://melonport.com/

risk-adjusted performance relative to the buy-and-hold benchmark and protects investors from dramatic losses.

Our offering is designed to fill an existing gap in the virtual currency investment space by providing an easy access to a less risky buy-and-hold Bitcoin alternative without significant entry barriers. We anticipate Hedged Bitcoin to bring the following benefits to individual as well as institutional investors:

- Significantly reduced loss aversion through a multiple-fold drawdown reduction;
- Participation in the virtual currency upsides;
- Improved risk-adjusted performance overcoming current Bitcoin limitations for portfolio diversification [7];
- Worldwide accessibility to individuals of any net worth without minimum investment limitations;
- Managed strategy leveraging a proprietary, scientifically sound market analysis technology;
- Reduced systemic risk of the overall virtual currency ecosystem.

Our hedging methodology is conceptually based on two key components. The first component provides insights into the dynamics of speculative crowding among the Bitcoin market participants, and identifies specific time periods of increased market susceptibility to any endogenous (such as a large sell order or even an order book liquidity drop) as well as exogenous (such as related news) factors. The second component translates the dynamic picture of the market state into algorithmically managed Bitcoin exposure. We now turn to a more technical overview of these components within the extent relevant to the Hedged Bitcoin value proposition.

3.1 Market instability detection

Ternary Intelligence has developed a model-based methodology for detecting instabilities in financial markets. The methodology analyzes market crowding from a behavioral perspective, building upon broadly applicable concepts of statistical physics and complex systems science. Instability signals highlight market trends that approach regions of significantly increased susceptibility to both endogenous and exogenous influences.

The universality of the underlying model allows signals to be generated for virtually any publicly traded financial asset, at different timesteps ranging from minutes to days. At each timestep, specific signals are generated providing quantitative information that includes measures of the instability size, criticality, and the level of instability development. The signals are designed to track the ongoing state of unsustainable market trends and to indicate when those trends are highly susceptible to a regime change.
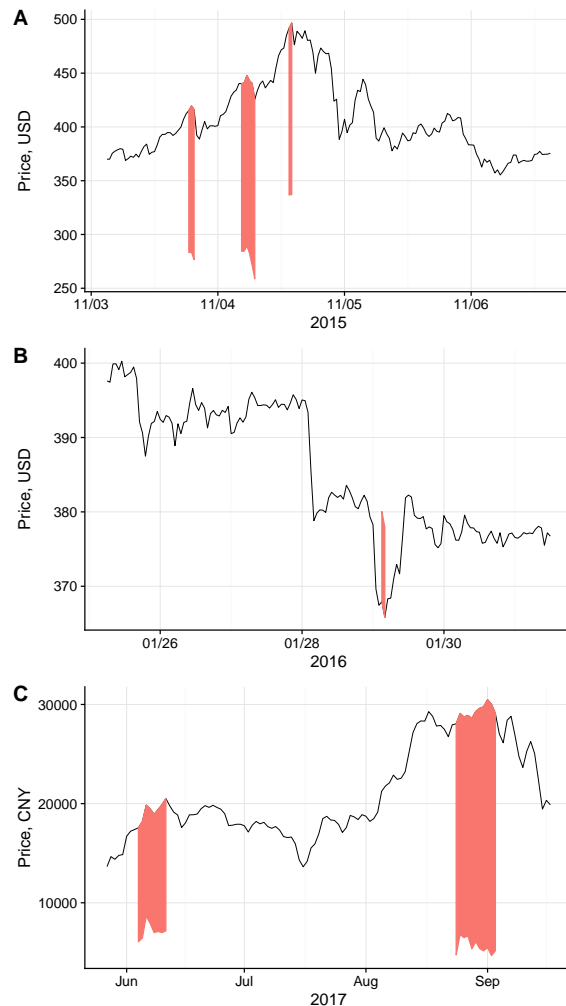

Figure 2: *Illustrative cases of market instability signals for Bitcoin. Signals were computed using (A) 30 minute, (B) hourly, and (C) daily detection modes. Colored regions indicate signal appearance times with the corresponding instability size in price units. The solid black line follows the Bitcoin price in each case.*

Our instability detection approach has been extensively applied to the stock, commodity, and foreign exchange markets through our institutional subscription service. Hedge funds find the methodology useful in applications ranging from risk management to alpha generation.

While providing market instability signals for equities, fiat currency pairs, and commodities as a subscription service, we have found the same methodology to be very well suited for identifying instabilities in virtual currency markets. This is expected to be the case since the crowding instability perspective fits very well with the global speculative nature of those markets (sec. 1).

Representative examples of Bitcoin market instability signals are illustrated in Figure 2. Part (A) corresponds

to a sequence of price acceleration cycles developed in November 2015, which preceded a loss of over a third of the Bitcoin value at the time. Part (B) shows an opposite case where an unsustainably accelerated sell-off in January 2016 produced a bearish instability prior to a temporary rebound. A longer-term price trend development in (C) tracks the market through a Chinese exchange as it approaches a correction in September 2017. The universality and time scale invariance of our instability detection methodology provides an advantage of being able to track the state of the market crowding at multiple time scales (Figure 2), alerting us of fast and slow herding cycles simultaneously. Note that, importantly, instability signals appear **prior** to the onset of market corrections, since extreme market susceptibility has to develop prior to an event causing a sell-off.

Our proprietary instability detection procedure allows, among other characteristics, to extract a measure of the instability size relative to the current asset price (shown as the height of the shaded signal areas in Figure 2). This metric is listed in the last column of Table 1 for a number of specific cases of Bitcoin speculative bubble bursts. We emphasize that **the instability signals were generated prior to the beginning of each market correction**. The ability to identify precursor patterns preceding increased market volatility is essential for timely asset conversion in a limited liquidity market.

3.2 Algorithmic hedging approach

The understanding of the Bitcoin trader crowd dynamics through the lens of the instability detection approach provides a solid foundation for designing appropriate hedging methodologies. Conceptually, the hedging scenario retains a portion of assets under management in Bitcoin. The other part, which we refer to as the hedge, is converted into US Dollars. The hedge ratio, i.e. the split of funds between the risky asset and the hedge, is algorithmically adjusted according to market conditions. As the market crowding becomes more unstable, the strategy reduces its Bitcoin exposure and faces potential price corrections with a larger portion of the assets in US Dollars.

The effect of the Bitcoin exposure being dynamically managed in response to market conditions according to our hedging strategy is highlighted in Figure 3 for a selected period of the Bitcoin price history. This time period is intentionally chosen to contain a bubble-like price acceleration phase (the largest to date, at the time of writing) with a subsequent correction and a bearish market period as a basic repeatable building block of the Bitcoin trading history. Panels (A) and (B) in Figure 3 distinguish two possible investment entry points, the one of an early investor (from the *a posteriori* bubble burst
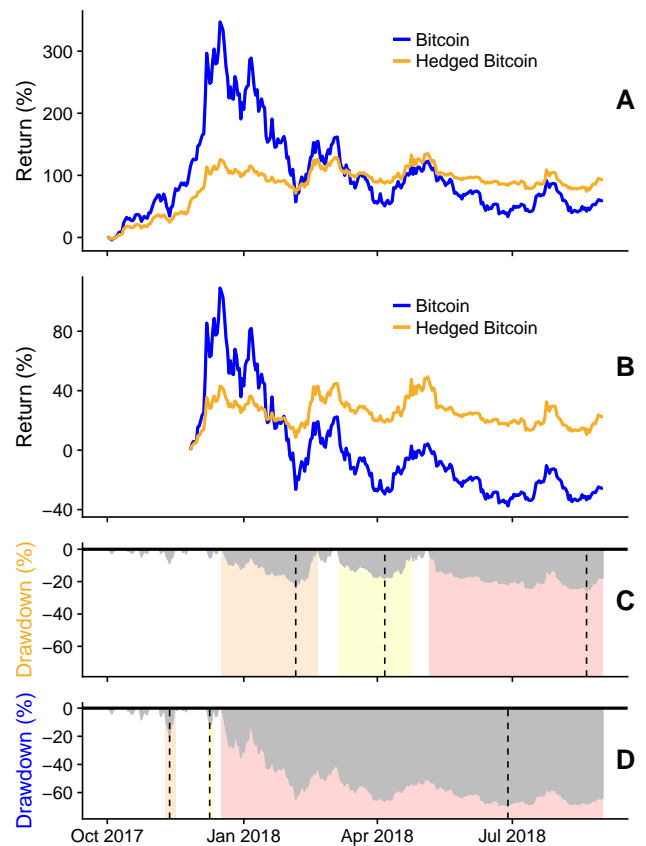

Figure 3: *Investment performance for the buy-and-hold Bitcoin benchmark ("Bitcoin", blue) and algorithmically hedged Bitcoin strategy ("Hedged Bitcoin", orange) over the time period that incorporates the largest to date speculative bubble (Table 1). Different investment entry dates of Oct 1 (A) and Nov 26 (B) illustrate the effect of entry timing. Drawdown plots (Hedged Bitcoin (C) and Bitcoin (D)) illustrate over three-fold risk reduction achieved through algorithmic hedging.*

perspective) and an average investor deciding to buy Bitcoin when it gained about half of its peak media attention (as gauged by the Google Trends data[||]). Note that Figure 3 (B) corresponds to the time when a growing number of mainstream retail investors would consider buying Bitcoin. The comparison illustrates a dramatic effect of entry timing for the buy-and-hold Bitcoin investment (the effect that was learned by many retail investors through the expensive lesson of large losses) and a significant drawdown reduction in the case of the Hedged Bitcoin strategy.

While the algorithmic hedging strategy does not quite achieve the Bitcoin peak price due to a gradually reduced exposure as the bubble dynamics becomes more unstable, it protects the investor from exceptionally large draw-

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[||] `https://trends.google.com/`, "bitcoin price" search term in the United States.

Bitcoin

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YR
2018	-28	2	-33	33	-19	-15	21	-9					-50
2017	0	23	-9	27	66	7	16	66	-9	49	54	40	1331
2016	-14	18	-4	9	17	27	-7	-9	6	14	7	31	126
2015	-32	16	-4	-3	-3	15	8	-19	3	33	20	14	34
2014	10	-31	-17	-2	40	2	-9	-18	-19	-13	11	-15	-56
2013									-3	60	453	-35	460

Hedged Bitcoin

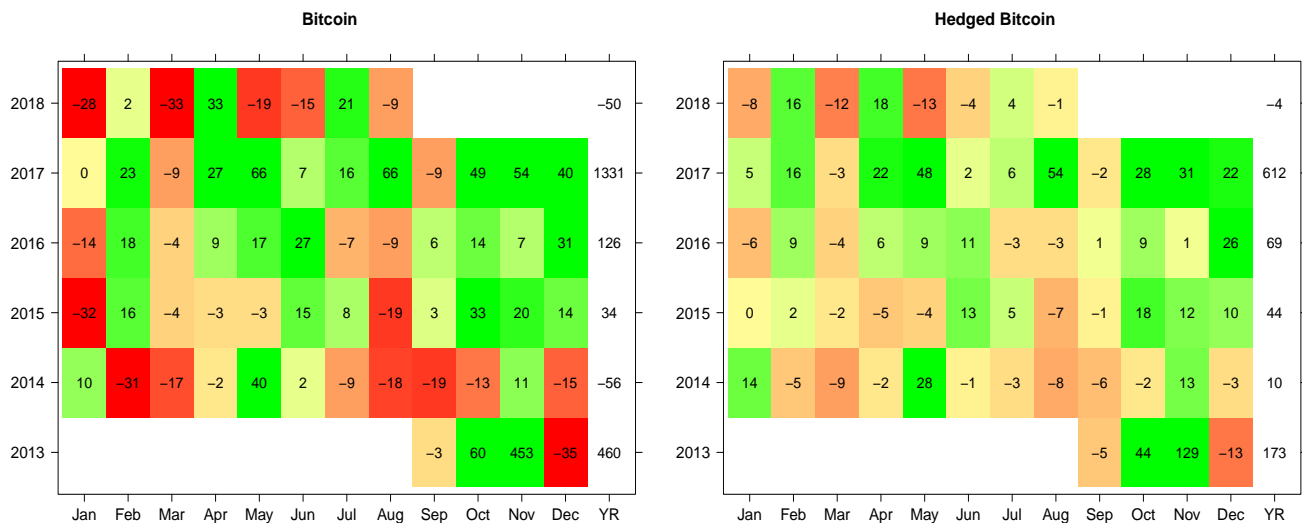| Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YR
2018	-8	16	-12	18	-13	-4	4	-1					-4
2017	5	16	-3	22	48	2	6	54	-2	28	31	22	612
2016	-6	9	-4	6	9	11	-3	-3	1	9	1	26	69
2015	0	2	-2	-5	-4	13	5	-7	-1	18	12	10	44
2014	14	-5	-9	-2	28	-1	-3	-8	-6	-2	13	-3	10
2013									-5	44	129	-13	173

Figure 4: *Monthly (labeled by the month) and annual (labeled "YR") cumulative returns (in %) for the buy-and-hold Bitcoin benchmark ("Bitcoin", left) and algorithmically hedged Bitcoin strategy ("Hedged Bitcoin", right). The backtest time interval covers five years of the Bitcoin history, and adequately incorporates realistic trading fees and slippage happening at major exchanges. A noticeable reduction in the number of significantly negative monthly returns is achieved through our algorithmic hedging approach.*

downs once the market correction starts to unfold. This illustrative pattern highlights a core of the presented hedging methodology designed to achieve superior risk-adjusted performance.

The results of a comprehensive five-year backtest of the Hedged Bitcoin strategy are presented in Figure 4 with the monthly and annual return breakdown from September 2013 through August 2018. Our backtesting incorporates trading fees and a realistic extent of slippage at major Bitcoin exchanges verified through live trading. The main highlight of the Hedged Bitcoin comparison with the buy-and hold benchmark in Figure 4 is a significant reduction in the number of large monthly losses, which makes Hedged Bitcoin a safer investment offering.

4   Summary

The highly speculative nature of global virtual currency markets translates into significant investment risks as frequent cycles of irrational exuberance are terminated with dramatic corrections. Such risks could be intolerable by many individual investors and present a roadblock for institutions [4, 7] who would otherwise be interested in investment scopes more broad than the mining hardware and the blockchain technology itself.

The current work presents a Hedged Bitcoin offering that fills an existing gap in the virtual currency investment space by limiting downside risk while capturing long-term market growth. Our dynamic hedging method-

ology, which integrates early detection of market crowding instabilities with the algorithmic management of the dynamic risky asset exposure, essentially solves the entry timing problem for a virtual currency investor.

Powered by a globally accessible financial platform[**], Hedged Bitcoin is positioned to generate a massive interest not only in developed countries but also in geographical areas where individual investors actively seek alternative value preservation schemes for their assets. With improved risk-adjusted characteristics, we provide a safer investment vehicle for the virtual currency space.

Furthermore, Hedged Bitcoin may have prominent applications in the emerging area of coin portfolio management. The availability of a dynamic hedge would give rise to virtual coin baskets where not only the idiosyncratic coin risk is diversified by the basket constituents, but also systemic risk of the entire virtual currency ecosystem is managed through the Hedged Bitcoin algorithmic strategy.

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