GRAYSCALE

The Modern Portfolio

The Case for Allocating to Digital Assets

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It's not every day, or even every decade, that an entirely new asset class is born. Yet, through a combination of computer science, cryptography, economics, and network theory, digital assets have arrived and are proving that they are an asset class unlike any other. As they transform our global financial infrastructure and challenge modern monetary theory[1], we believe digital assets are one of the most exciting investment opportunities of the 21st century. In this piece, we will demonstrate why we view digital assets as a new asset class that can enhance strategic asset allocation and help investors build portfolios with higher risk-adjusted returns.

New asset classes are rare and powerful because they offer a unique return stream that can diversify a portfolio. This might seem like a simple concept, but few investors truly appreciate the impact this can have on the return/risk profile of a portfolio, and subsequent wealth creation. As Cliff Asness, Managing Principal and CIO of AQR Capital Management, has said, "diversification is the one free lunch of investing, and when you see a free lunch, the only rational thing to do is eat."[2]

Consistent with Modern Portfolio Theory, we generally subscribe to the notion that the optimal return/risk ratio for a portfolio can be found on the efficient frontier. But contrary to conventional wisdom, we think many of today's asset allocators are missing out on a "free lunch." That's because (i) digital assets represent a brand new investment opportunity that is uncorrelated to other asset classes and (ii) investors are generally under-allocated to this sector.

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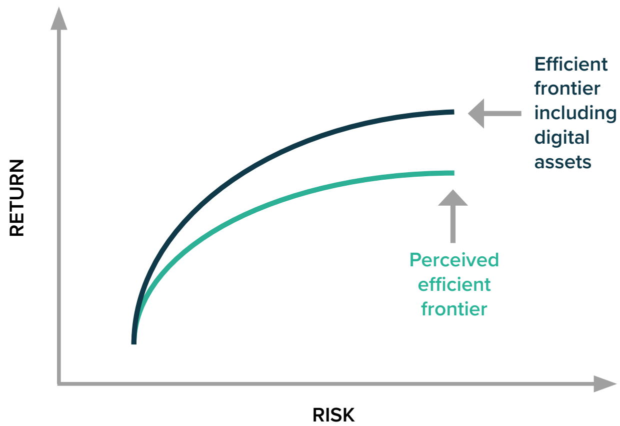
1. Economic Research: Federal Reserve Bank of St. Louis. The Case for Central Bank Electronic Money and the Non-case for Central Bank Cryptocurrencies. Vol. 100, No.2, April 16, 2018. Aleksander Berentsen and Fabian Schar. https://research.stlouisfed.org/publications/review/2018/02/13/the-case-for-central-bank-electronic-money-and-the-non-case-for-central-bankcryptocurrencies.
2. AQR Perspective: Efficient Frontier "Theory for the Long Run. Cliff Asness, December 10, 2014. https://www.aqr.com/Insights/Perspectives/Efficient-Frontier-Theory-for-the-Long-Run.

It is our view that the optimal beta portfolio[3] lies somewhere higher than what was previously believed to be the efficient frontier, and digital assets are the proverbial "missing piece of the puzzle."

FIGURE 1: **THE NEW EFFICIENT FRONTIER**



Digital currencies, like Bitcoin, seek to fulfill the role of a decentralized global currency and store-of-value. Others, like Zcash (ZEC) and Monero (XMR), build upon Bitcoin's role by offering privacy-enhancing features. Digital commodities, like Ethereum (ETH), fuel decentralized applications (DApps) that can execute condition-based transactions through the use of smart contracts, while assets like Ethereum Classic (ETC) are a hybrid currency and commodity, combining the monetary attributes that have made Bitcoin a digital store-of-value with the smart contract capabilities of Ethereum. These are just a few examples of how digital assets are functioning today.

Moreover, digital assets are at the intersection of some of the most significant trends reshaping the global economy[4], including:

- Advancements in financial technologies and payment infrastructure.
- Regulatory shifts, altering financial industry economics and increasing the cost of compliance.
- Demographic shifts, driven by (i) the next generation of investors entering their prime earning years (i.e., millennials) and (ii) retirement obligations, financed primarily by equity and bond investments, coming due.

Combining the growth opportunities that digital assets offer as a new technology and the store of-value characteristics that many of them possess as alternative currencies, digital assets may have the potential to provide both inflation protection and growth exposure concurrently.

3. A "beta portfolio" is a theoretical portfolio of investments that includes every type of asset available in the global financial market, with each asset weighted in proportion to its total presence in the market. The "optimal beta portfolio" is the portfolio that includes every type of asset available in the global financial market, with each asset weighted in order to maximize the return of the portfolio per unit of risk. Source: Investopedia.
4. BlackRock: Built for Change. Geraldine Buckingham, Global Head of Corporate Strategy. June 2016. http://ir.blackrock.com/Cache/1500088361.PDF?O=PDF&T=&Y=&D=&FID=1500088361&iid=4048287.

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Below we examine the relationship that some established digital assets have to traditional assets and each other through a correlation matrix constructed from rolling one-month returns over the last five and a half years.

FIGURE 2: **MULTI-ASSET CORRELATION MATRIX**[5]

September 25, 2013 through February 28, 2019. Based on Rolling One-Month Returns

Asset	Bitcoin BTC	Bitcoin Cash BCH	Ethereum ETH	Ethereum Classic ETC	Litecoin LTC	Stellar Lumens XLM	XRP XRP	Zcash ZEC	Zen ZEN	Grayscale Digital Large Cap Fund "DLC"
S&P 500 Index	0.19	0.11	0.08	0.13	0.08	0.11	0.05	0.09	0.14	0.18
Nasdaq Composite	0.17	0.14	0.04	0.16	0.08	0.12	0.09	0.08	0.12	0.18
MSCI World Index	0.15	0.13	0.11	0.19	0.06	0.15	0.09	0.15	0.18	0.21
MSCI EAFE Index	0.11	0.16	0.16	0.30	0.05	0.21	0.14	0.25	0.23	0.27
MSCI Emerging Markets Index	0.00	0.12	0.17	0.15	-0.03	0.13	0.09	0.16	0.13	0.05
Bloomberg Commodity Index	-0.02	0.19	-0.02	-0.15	0.02	-0.01	0.03	-0.14	0.23	0.24
Barclays Capital Bond Index	-0.05	0.04	0.27	0.26	-0.04	0.07	0.07	0.26	-0.04	-0.35
COMEX Gold Index	-0.18	0.07	0.31	0.04	-0.18	-0.04	0.02	0.15	0.11	-0.01
DJCME Spot FX Index	-0.02	0.01	0.23	0.23	0.03	0.13	0.14	0.21	-0.10	-0.22
Swiss Franc (CHF)	-0.05	0.08	0.17	0.02	-0.05	-0.01	0.02	0.07	-0.03	0.15
Canadian Dollar (CAD)	0.04	0.06	0.24	0.31	0.09	0.21	0.20	0.25	-0.03	-0.17
British Pound (GBP)	-0.14	0.02	0.22	0.10	-0.16	0.05	0.02	0.12	-0.04	-0.09
Euro (EUR)	0.05	0.06	0.19	0.08	0.08	0.08	0.12	0.14	0.04	-0.14
Japanese Yen (JPY)	-0.13	0.00	0.18	0.10	-0.14	-0.09	-0.07	0.17	-0.09	-0.14
Chinese Renminbi (RMB)	0.05	-0.06	0.08	0.05	0.01	0.00	-0.03	0.01	-0.01	-0.08
Russian Ruble (RUB)	0.03	0.17	0.04	0.14	0.02	0.01	-0.02	0.11	0.24	0.10
Argentine Peso (ARS)	0.07	-0.03	0.02	0.09	0.17	0.13	0.15	-0.09	-0.13	-0.13
Thai Baht (THB)	0.00	0.09	0.30	0.18	-0.02	0.09	0.08	0.23	-0.04	-0.19
Singapore Dollar (SGD)	-0.08	0.02	0.10	-0.03	-0.07	-0.01	-0.04	-0.09	-0.07	0.24
Brazilian Real (BRL)	-0.07	-0.13	0.16	0.22	0.03	0.07	0.08	0.18	-0.23	-0.41

Maximum: 0.31
Minimum: -0.41
Average: 0.06

Bitcoin (BTC)	1.00	0.57	0.32	0.59	0.81	0.45	0.35	0.51	0.60	0.93
Bitcoin Cash (BCH)	0.57	1.00	0.58	0.75	0.44	0.40	0.27	0.66	0.55	0.92
Ethereum (ETH)	0.32	0.58	1.00	0.78	0.32	0.35	0.37	0.88	0.52	0.90
Ethereum Classic (ETC)	0.59	0.75	0.78	1.00	0.58	0.60	0.48	0.79	0.46	0.86
Litecoin (LTC)	0.81	0.44	0.32	0.58	1.00	0.53	0.47	0.45	0.31	0.81
Stellar Lumens (XLM)	0.45	0.40	0.35	0.60	0.53	1.00	0.76	0.45	0.46	0.83
XRP (XRP)	0.35	0.27	0.37	0.48	0.47	0.76	1.00	0.48	0.25	0.73
Zcash (ZEC)	0.51	0.66	0.88	0.79	0.45	0.45	0.48	1.00	0.57	0.89
Zen (ZEN)	0.60	0.55	0.52	0.46	0.31	0.46	0.25	0.57	1.00	0.72
Grayscale Digital Large Cap Fund ("DLC")	0.93	0.92	0.90	0.86	0.81	0.83	0.73	0.89	0.72	1.00

Maximum: 0.93
Minimum: 0.25
Average: 0.58

From the previous tables, we can see that the correlations of rolling one-month returns range from negative to slightly positive, with an average of near zero. This provides evidence that digital assets can be considered a diversifying component in multi-asset portfolios. Moreover, many digital assets are imperfectly correlated to one another, which indicates there may be diversification benefits within the asset class itself.

To gain a deeper understanding of these benefits, we conducted a series of portfolio simulations to assess how an allocation to an equal-weighted mix of select digital assets might have impacted the return/risk profile of a portfolio comprised of global equities and bonds (the "Global 60/40").[6]

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5. Source: Bloomberg, CoinMarketCap.com. Based on one-month rolling returns from September 25, 2013 through February 28, 2019. We selected the timeframe for our analysis because we believe it broadly constitutes the most complete historical dataset for the digital assets that we have chosen to analyze. For the sake of consistency and for comparison purposes, we will use this timeframe throughout the paper. The digital assets shown above have historically experienced significant intraday and long-term price swings. As the period during which these digital assets have been available for trading is limited, the correlations may not be meaningful when considering longer periods. Past performance is not indicative of future results.
6. "Global 60/40" consists of a 60% allocation to the iShares MSCI ACWI and a 40% allocation to the Vanguard Total International Bond ETF.

FIGURE 3: **DIGITAL ASSET ALLOCATION IN HYPOTHETICAL SIMULATED PORTFOLIO**

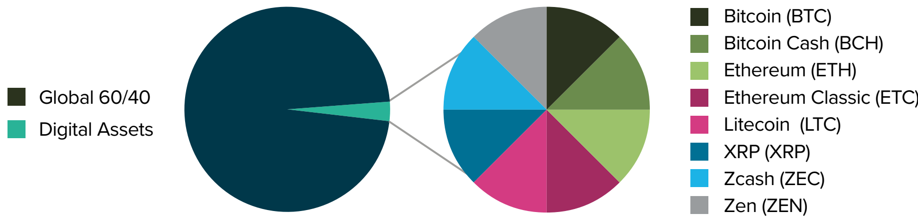
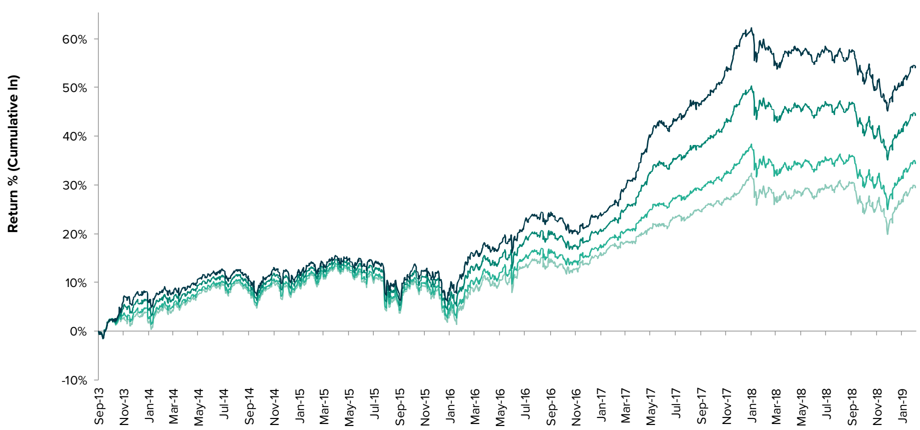


FIGURE 4: **HYPOTHETICAL SIMULATED PORTFOLIO PERFORMANCE**[7]
September 25, 2013 through February 28, 2019.

PORTFOLIO	Global 60/40	Global 60/40 +1% Digital Assets	Global 60/40 +3% Digital Assets	Global 60/40 +5% Digital Assets
Total Return (Cumulative)	34.3%	41.2%	55.8%	71.8%
Total Return (Annualized)	5.7%	6.6%	8.6%	10.6%
Risk (Annualized Std Dev)	7.8%	7.7%	7.8%	8.2%
Sharpe Ratio	0.65	0.78	1.02	1.23
Ratio Improvement	**--**	**20.0%**	**57.2%**	**88.8%**



7. HYPOTHETICAL SIMULATED PERFORMANCE RESULTS HAVE CERTAIN INHERENT LIMITATIONS. There is no guarantee that the market conditions during the past period will be present in the future. Rather, it is most likely that the future market conditions will differ significantly from those of this past period, which could have a materially adverse impact on future returns. Unlike an actual performance record, simulated results do not represent actual trading or the costs of managing the portfolio. Also, since the trades have not actually been executed, the results may have under or over compensated for the impact, if any, of certain market factors, such as lack of liquidity. Simulated trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. PAST PERFORMANCE IS NOT INDICATIVE OF FUTURE RESULTS.
Source: Bloomberg, CoinMarketCap.com. Performance is shown from September 25, 2013 through February 28, 2019. We selected the timeframe for our analysis because we believe it broadly constitutes the most complete historical dataset for the digital assets that we have chosen to analyze. For the sake of consistency and for comparison purposes, we will use this timeframe throughout the paper. Annualized figures are based on 252 trading days. "Global 60/40" consists of a 60% allocation to the iShares MSCI ACWI and a 40% allocation to the Vanguard Total International Bond ETF. "Digital Assets" consists of an equal-weighted mix of Bitcoin (BTC), Bitcoin Cash (BCH), Ethereum (ETH), Ethereum Classic (ETC), Litecoin (LTC), XRP (XRP), Zcash (ZEC), and Zen (ZEN). THE GLOBAL 60/40 + 1%/3%/5% DIGITAL ASSETS RESULTS ARE HYPOTHETICAL AND ARE NOT BASED ON ACTUAL RETURNS OR HISTORICAL PERFORMANCE. DIGITAL ASSETS HAVE HISTORICALLY EXPERIENCED SIGNIFICANT INTRADAY AND LONG-TERM PRICE SWINGS AND PAST PERFORMANCE IS NOT NECESSARILY INDICATIVE OF FUTURE RESULTS. Component asset weights are held constant over the period. The Sharpe Ratio is calculated as the annualized excess return of the portfolio over the 3-month US T-Bill divided by the standard deviation of excess returns. Ratio improvement is calculated by taking the Sharpe Ratio of the Global 60/40 + 1%/3%/5% Digital Assets Portfolios and dividing each by the Sharpe Ratio of the Global 60/40 Portfolio.

Looking at the results above, it appears that portfolios containing an allocation to digital assets performed even better than the Global 60/40, on both an absolute and risk-adjusted basis. For example:

- Adding a 1% digital asset allocation increased the hypothetical simulated cumulative return by 6.9%, without materially increasing volatility to improve risk-adjusted returns by 20%.

- Adding a 3% digital asset allocation increased the hypothetical simulated cumulative return by 21.5%, without materially increasing volatility to improve risk-adjusted returns by 57%.

- Adding a 5% digital asset allocation increased the hypothetical simulated cumulative return by 37.5%, without materially increasing volatility to improve risk-adjusted returns by 89%.

Given what we know about Modern Portfolio Theory, this is not all that surprising. Since digital assets are uncorrelated with traditional assets and imperfectly correlated with one another, they can be combined to build portfolios with higher risk-adjusted returns.

Conclusion

Early investors in digital assets have long believed in their potential to capture a share of some of the largest markets in the world (e.g., store-of-value), improve the efficiency of our global financial system, and create business models that democratize information and value in new ways. Investors also recognize that because of their highly unique set of properties, digital assets offer a distinct return stream, allowing them to play a diversifying role in their portfolios.

It's still early in the lifecycle of digital assets, but there is a compelling case for investors to allocate some portion of their portfolio to this new asset class. A lot can happen over the next few years, but remember: diversification is a "free lunch" and asset allocation is all about the long-game.

Important Disclosures & Other Information

This paper is for informational purposes only and does not constitute an offer to sell or the solicitation of an offer to sell or buy any security in any jurisdiction where such an offer or solicitation would be illegal. There is not enough information contained in this paper to make an investment decision and any information contained herein should not be used as a basis for this purpose. This paper does not constitute a recommendation or take into account the particular investment objectives, financial situations, or needs of investors. Investors are not to construe the contents of this paper as legal, tax or investment advice, and should consult their own advisors concerning an investment in digital assets. The price and value of assets referred to in this research and the income from them may fluctuate. Past performance is not indicative of the future performance of any assets referred to herein. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

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The hypothetical simulated performance results are based on a model that used inputs that are based on assumptions about a variety of conditions and events and provides hypothetical not actual results. As with all mathematical models, results may vary significantly depending upon the value of the inputs given, so that a relatively minor modification of any assumption may have a significant impact on the result. Among other things, the hypothetical simulated performance calculations do not take into account all aspects of the applicable asset's characteristics under certain conditions, including characteristics that can have a significant impact on the results. Further, in evaluating the hypothetical simulated performance results herein, each prospective investor should understand that not all of the hypothetical assumptions used in the model are described herein, and conditions and events that are not accounted for by the model may have a significant adverse effect on the performance of the assets described herein. Prospective investors should consider whether the behavior of these assets should be tested based on different and/or additional assumptions from those included in the information herein.

IN ADDITION TO OTHER DIFFERENCES, PROSPECTIVE INVESTORS IN A PRODUCT SHOULD NOTE THE FOLLOWING POTENTIALLY SIGNIFICANT DIFFERENCES BETWEEN THE ASSUMPTIONS MADE IN THE HYPOTHETICAL SIMULATED PERFORMANCE RESULTS INCLUDED HEREIN AND THE CONDITIONS UNDER WHICH A PRODUCT WILL PERFORM, WHICH COULD CAUSE THE ACTUAL RETURN OF SUCH PRODUCT TO DIFFER CONSIDERABLY FROM RETURNS SET FORTH BY THE HYPOTHETICAL SIMULATED PERFORMANCE, TO BE MATERIALLY LOWER THAN THE RETURNS AND TO RESULT IN LOSSES OF SOME OR ALL OF THE INVESTMENT BY PROSPECTIVE INVESTORS:

FOR EXAMPLE, EACH TRUST WILL HOLD ONLY ONE DIGITAL ASSET, WHEREAS THE HYPOTHETICAL SIMULATED PERFORMANCE RESULTS ARE INTENDED TO SHOW HYPOTHETICAL PERFORMANCE OF AN INVESTMENT MULTIPLE DIGITAL ASSETS. IN ADDITION, THE GENERAL MARKET DATA USED IN THE HYPOTHETICAL SIMULATED PERFORMANCE RESULTS DO NOT REFLECT ACTUAL TRADING ACTIVITY AND COULD NOT BE REPLICATED BY A PRODUCT IN ITS ACTUAL TRANSACTIONS. If actual trading activity was executed at levels that differed significantly from the general market data used in the hypothetical simulated performance, the actual returns achieved would have varied considerably from the results of the hypothetical simulated performances and could have been substantially lower and could result in significant losses.

IN ADDITION, THE HYPOTHETICAL SIMULATED PERFORMANCE RESULTS DO NOT ASSUME ANY GAINS OR LOSSES FROM TRADING AND THEREFORE DO NOT REFLECT THE POTENTIAL LOSSES, COSTS AND RISKS POSED BY TRADING AND HOLDING ACTUAL ASSETS.

The hypothetical simulated performance results do not reflect the impact the market conditions may have had upon a Product were it in existence during the historical period selected. The hypothetical simulated performance results do not reflect any fees incurred by a Product. If such amounts had been included in the hypothetical simulated performance, the results would have been lowered.

AS A RESULT OF THESE AND OTHER DIFFERENCES, THE ACTUAL RETURNS OF A PRODUCT MAY BE HIGHER OR LOWER THAN THE RETURNS SET FORTH IN THE HYPOTHETICAL SIMULATED PERFORMANCE RESULTS, WHICH ARE HYPOTHETICAL AND MAY NEVER BE ACHIEVED. Reasons for a deviation may also include, but are by no means limited to, changes in regulatory and/or tax law, generally unfavorable market conditions and the Risk Factors set forth below.

Certain Risk Factors

Each Product is a private, unregistered investment vehicle and not subject to the same regulatory requirements as exchange traded funds or mutual funds, including the requirement to provide certain periodic and standardized pricing and valuation information to investors. There are substantial risks in investing in a Product or in digital assets directly, including but not limited to:

- **PRICE VOLATILITY**
  Digital assets have historically experienced significant intraday and long-term price swings. In addition, none of the Products currently operates a redemption program and may halt creations from time to time or, in the case of Grayscale Bitcoin Trust (BTC), periodically. There can be no assurance that the value of the common units of fractional undivided beneficial interest ("Shares") of any Product will approximate the value of the digital assets held by such Product and such Shares may trade at a substantial premium over or discount to the value of the digital assets held by such Product. At this time, none of the Products is operating a redemption program and therefore Shares are not redeemable by any Product. Subject to receipt of regulatory approval from the SEC and approval by Grayscale, in its sole discretion, any Product may in the future operate a redemption program. Because none of the Products believes that the SEC would, at this time, entertain an application for the waiver of rules needed in order to operate an ongoing redemption program, none of the Products currently has any intention of seeking regulatory approval from the SEC to operate an ongoing redemption program.

- **MARKET ADOPTION**
  It is possible that digital assets generally or any digital asset in particular will never be broadly adopted by either the retail or commercial marketplace, in which case, one or more digital assets may lose most, if not all, of its value.

- **GOVERNMENT REGULATION**
  The regulatory framework of digital assets remains unclear and application of existing regulations and/or future restrictions by federal and state authorities may have a significant impact on the value of digital assets.

- **SECURITY**
  While each Product has implemented security measures for the safe storage of its digital assets, there have been significant incidents of digital asset theft and digital assets remains a potential target for hackers. Digital assets that are lost or stolen cannot be replaced, as transactions are irrevocable.

- **TAX TREATMENT OF VIRTUAL CURRENCY**
  For U.S. federal income tax purposes, Digital Large Cap Fund will be a passive foreign investment company (a "PFIC") and, in certain circumstances, may be a controlled foreign corporation (a "CFC"). Digital Large Cap Fund will make available a PFIC Annual Information Statement that will include information required to permit each eligible shareholder to make a "qualified electing fund" election (a "QEF Election") with respect to Digital Large Cap Fund. Each of the other Products intends to take the position that it is a grantor trust for U.S. federal income tax purposes. Assuming that a Product is properly treated as a grantor trust, Shareholders of that Product generally will be treated as if they directly owned their respective pro rata shares of the underlying assets held in the Product, directly received their respective pro rata shares of the Product's income and directly incurred their respective pro rata shares of the Product 's expenses. Most state and local tax authorities follow U.S. income tax rules in this regard. Prospective investors should discuss the tax consequences of an investment in a Product with their tax advisors

- **NO SHAREHOLDER CONTROL**
  Grayscale, as sponsor of each Trust and the manager of the Fund, has total authority over the Trusts and the Fund and shareholders' rights are extremely limited.

- **LACK OF LIQUIDITY AND TRANSFER RESTRICTIONS**
  An investment in a Product will be illiquid and there will be significant restrictions on transferring interests in such Product. The Products are not registered with the SEC, any state securities laws, or the U.S. Investment Company Act of 1940, as amended, and the Shares of each Product are being offered in a private placement pursuant to Rule 506(c) under Regulation D of the Securities Act of 1933, as amended (the "Securities Act"). As a

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  The Products and their sponsors or managers and advisors may rely on the trading expertise and experience of third-party sponsors, managers or advisors, the identity of which may not be fully disclosed to investors. The Products and their sponsors or managers and advisors and agents may be subject to various conflicts of interest.

- **FEES AND EXPENSES**
  Each Product's fees and expenses (which may be substantial regardless of any returns on investment) will offset each Product's trading profits.

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