The anatomy of alternatives

Exploring correlation and fit within the portfolio mix

First Sentier Investors

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- Alternative investments are supposed to provide uncorrelated, low-beta[1] characteristics to dampen portfolio volatility and improve risk-adjusted returns, but outcomes are not always linear
- The role alternatives play within portfolios should be considered in light of the recent and possible performance of traditional assets
- Analysis shows not all alternatives are created equal. Attention should be given to the underlying characteristics of various asset class categories to achieve an optimal mix within portfolios

The holy grail of asset allocation is to find positively compounding real return assets that are negatively correlated to traditional investments like stocks and bonds. This paper investigates just how effective some low-beta strategies designed to dampen portfolio volatility and improve risk-adjusted returns have actually been. Given how well equities and bonds have performed, this paper also considers whether alternatives are a worthy addition to portfolios from a risk adjusted returns perspective.

Our key findings indicate that asset classes with differing payoff profiles from traditional assets may indeed be attractive for possible inclusion in an institutional portfolio to improve risk-adjusted performance outcomes, thanks to a combination of return enhancement and/or diversification benefits. However, not all alternatives were negatively correlated to traditional asset classes over the period analysed. While some asset classes such as fine wine delivered on their promise, others including freight and Bitcoin delivered significantly higher returns than traditional assets, accompanied by exceptionally higher volatility.

1. Please refer to the glossary for the definition.

Because inclusion of alternative investments can significantly broaden the investment universe, we have constrained our examination to cover seven asset categories including: cryptocurrencies, freight, timber & forestry, frontier equities, distressed opportunities, fine wine and catastrophe bonds. We have chosen asset categories that lend themselves to analytical modelling and are broadly accessible to investor groups mindful of illiquidity constraints.

An alternative investment is a financial asset that does not fit into the mainstream equity (corporate stocks), income (debt issued by corporations or governments) or cash (low-risk deposits) investment categories. In this paper, we examine the characteristics of alternatives to see what differentiates them from traditional assets, and importantly, consider how they could be integrated into portfolios for long-term investors.

Characteristics of alternative investments

Alternative investments cover a broad spectrum of assets. Generalising, we would say they are characterised by:

- Low correlation, and beta, to traditional investments such as equities and bonds. This can be due to non-traditional cash flows and funding profiles.
- Often complex investment structures and risk-return profiles that don't lend themselves to mean-variance analytical modelling[2].
- Typically, high minimum investment requirements and capacity constraints.
- Unique risk profile, including more esoteric assets that ideally require specialist knowledge and understanding before investing.
- Often illiquid or with a limited liquidity profile, reducing the ability to rebalance and manage the portfolio to a strategic asset allocation[3].
- Information asymmetry exists due to a small number of well-informed individuals or corporations and information can be limited before being broadly available.
- Trading impediments can exist including high transaction costs, taxes and non-standardised settlement.

Art (collectibles) case study

Collectibles, art in particular, is a relatively small and unregulated market where value is generally correlated with scarcity. Art as an investment is illiquid, lacks transparency and can have significant deviations in supply and demand. Accordingly, valuing art is an imprecise exercise and includes a significant level of subjectivity. Even experts can disagree on the authenticity of some of the most valuable items[4] – this is the basis of an interesting 2021 movie '*The Lost Leonardo*'.

In addition to the aforementioned issues, storing collectibles can involve meaningful costs in addition to the transaction costs, commissions, auction premiums, expert advice and authentication. Art therefore tends not to be held directly within institutional portfolios, which require a custodian to ensure the safekeeping of assets.

Investors who may benefit from alternative investments

As a result of alternative investments' unique risk-return profiles, liquidity considerations and other complex investment characteristics, they are often most suitable for institutional investors. That said, given the aforementioned characteristics, it is important to consider the investment objectives – particularly the investment time-horizon and liquidity needs.

Educational endowments are one investment group that tends to have significant alternative investment allocations. These institutions have long-term investment horizons and lower liquidity requirements. The National Association of College and University Business Officers (NACUBO) shows that large endowments have almost 60% in alternatives, which has remained stable since the late 2000s[5].

In 2020 the global equity market's capitalisation was US$106 trillion, while the global bond market was valued at US$124 trillion; combining for an investable US$230 trillion[6]. While the value of the alternatives industry set a new high, at US$10 trillion[7] it remains small compared to traditional investment markets.

2. Please refer to the glossary for the definition.
3. Please refer to the appendix for an overview of the benefits and disadvantages of illiquid versus liquid assets.
4. https://www.bloomberg.com/news/articles/2017-11-16/is-the-450-million-salvator-mundi-leonardo-da-vinci-painting-a-fake.
5. https://www.nacubo.org/Research/2021/Historic-Endowment-Study-Data as at 31 January 2022.
6. https://www.sifma.org/wp-content/uploads/2021/07/CM-Fact-Book-2021-SIFMA.pdf as at 31 January 2022.
7. https://docs.preqin.com/reports/Preqin-Alternatives-in-2020-Report.pdf as at 31 January 2022.

"In theory, there is no difference between theory and practice, while in practice, there is."

Benjamin Brewster, industrialist and financier – The Yale Literary Magazine

As practitioners, we often consider alternative investments for portfolios

Alternative investments allow us to broaden the investment universe, increase diversification benefits, and thus maximise risk-adjusted returns[8]. These allocations are often illiquid, however, which changes the portfolio's liquidity structure and may deter open-ended funds[9] that require daily liquidity. Liquidity risk is one of the most critical, but least quantified, risk dimensions in portfolio construction[10].

For this reason, we constrain this document to an examination of seven alternative asset categories that are broadly assessable and lend themselves to analytical modelling. These categories are described in the table on the following page and the indices are available in the appendix.

8. Please refer to glossary for the definition.
9. Please refer to glossary for the definition.
10. As Edwin Schooling Latter of the FCA stated "Where an open-ended fund offers daily redemptions, but a significant proportion of the assets in which the fund invests cannot be liquidated within a day without material loss of value, there is an asset-liability mismatch." And "This asset-liability mismatch in the fund's structure, and the first mover incentive, introduces a source of instability in the fund." https://www.fca.org.uk/news/speeches/open-ended-funds-investing-less-liquid-assets.

Asset class	Description and considerations
Cryptocurrency	New decentralised, independent, digital currencies – including Bitcoin – with no institution controlling the network, which carries security and regulatory risks. For the purpose of this paper, we will use Bitcoin as a proxy for cryptocurrency to carry out our analysis.
Freight	Difficult to track as an investment and needs to have proxy exposure via listed companies, commodity producers, or commodities.
Timber and forestry	Provides environmental benefits, fuel source and used in construction, and can be accessed through listed companies.
Frontier equities	Frontier markets can have political instability, poor liquidity, inadequate regulation, substandard financial reporting and large currency fluctuations.
Distressed opportunities	Trade at discounts due to difficulties in assessing their value, lack of research coverage, or inability of traditional investors to continue holding them.
Fine wine	Has limited and falling supply and appreciates with age. Due to custody requirements, the investment would be in the listed wine and beverage industry.
Catastrophe bonds	Issued to provide capital capacity in the event of a natural catastrophe, which is difficult to predict and unrelated to economic cycles.

For illustrative purposes only. Reference to the names of each asset mentioned in this communication is merely for explaining the investment strategy and First Sentier Investors does not necessarily maintain positions in such assets. Any asset mentioned in this presentation does not constitute any offer or inducement to enter into any investment activity nor is it a recommendation to purchase or sell any security.

Historical return characteristics

The table below presents the historical returns, volatilities and correlation coefficients for several asset classes based on monthly returns over the period 28 February 2013 to 30 June 2022. This period has been analysed throughout this paper.

			Correlations															
Asset classes	Historical return	Historical volatility	US Equities	World (ex US) Equities	MSCI World Small Cap	Emerging Markets Equities	Global Bonds	US TIPS	US High Yield	USD Cash	Bitcoin	Freight	Timber and Forestry	Frontier Equities	Distressed opportunities	Wine	Catastrophe Bonds
US Equities	13.6%	15.7%	**1.00**														
World (ex US) Equities	5.3%	14.9%	0.87	**1.00**													
MSCI World Small Cap	9.5%	17.8%	0.92	0.90	**1.00**												
Emerging Markets Equities	3.4%	16.5%	0.70	0.80	0.74	**1.00**											
Global Bonds	2.2%	3.2%	0.18	0.16	0.15	0.21	**1.00**										
US TIPS[11]	1.7%	4.5%	0.28	0.34	0.29	0.38	0.78	**1.00**									
US High Yield	3.9%	7.5%	0.76	0.80	0.83	0.73	0.37	0.47	**1.00**								
USD Cash	0.9%	0.2%	-0.08	-0.07	-0.11	-0.02	0.15	0.07	-0.03	**1.00**							
Bitcoin	294.2%	1150.2%	0.11	0.08	0.09	0.05	0.05	0.03	0.09	-0.05	**1.00**						
Freight	70.3%	179.1%	0.07	0.07	0.10	0.10	-0.08	0.02	0.07	-0.05	0.00	**1.00**					
Timber and Forestry	6.6%	20.8%	0.78	0.80	0.85	0.70	0.08	0.28	0.70	-0.12	0.05	0.02	**1.00**				
Frontier Equities	4.1%	16.8%	0.67	0.74	0.73	0.70	0.15	0.24	0.73	-0.11	0.11	0.07	0.58	**1.00**			
Distressed opportunities	4.1%	5.8%	0.66	0.73	0.76	0.57	0.01	0.13	0.71	-0.17	0.13	0.07	0.59	0.68	**1.00**		
Wine	2.9%	4.6%	0.07	0.06	0.11	0.13	0.01	0.14	0.23	-0.12	-0.06	0.13	0.14	0.08	0.12	**1.00**	
Catastrophe Bonds	4.8%	3.1%	0.19	0.16	0.18	0.21	0.17	0.14	0.27	-0.13	0.05	0.01	0.21	0.18	0.20	0.15	**1.00**

Source: First Sentier Investors, Bloomberg, Datastream. To be consistent across the historical data, we restrict data to the shortest history of the alternative assets, being Bitcoin, which is from 28 February 2013 to 30 June 2022. Past performance is not indicative of future performance. Historical returns are gross performance and do not take into account any fees.

11. US Treasury Inflation Protected Securities.

Over this period, freight and Bitcoin have had significantly higher returns than traditional assets, albeit with exceptionally high volatility. While these assets tend to have low correlations to traditional assets, the significant volatility means that they would only be appropriate as a small allocation within a portfolio.

Also noteworthy, fine wine typically has a low correlation with traditional assets. Although when compared with global bonds, it has higher volatility and a lower return. This underlines the benefit of global bonds as a particularly useful diversifier for equity risk due to its low correlation, moderate return and low volatility.

To extend the picture for alternatives, we can examine their betas with traditional asset classes, such as US equities. Beta is a useful measure, as it explains the sensitivity to systematic market risks. The significant Bitcoin beta shows that it is strongly influenced by US equity risk, but the low correlation indicates that idiosyncratic factors are driving the returns.

The beta of alternative asset classes with US Equities[12]

Asset class	Beta
Bitcoin	7.74
Freight	0.76
Timber and Forestry	1.04
Frontier Equities	0.72
Distressed opportunities	0.24
Wine	0.02
Catastrophe Bonds	0.04

Source: First Sentier Investors, Bloomberg, Datastream as at 30 June 2022.

The table also illustrates that timber and forestry, and frontier equities, which have betas closer to one and high correlations with equities, are largely driven by systematic risks and would be expected to deliver similar performance outcomes to US equities. They do not appear to be uncorrelated, low-beta strategies that can dampen portfolio volatility and improve risk-adjusted returns.

Expected asset class characteristics

To determine the expected asset class characteristics, we derive long-term statistical characteristics for the asset categories and the economic environment as a whole[13]. This modelling of expected characteristics lends itself more to traditional assets due to their economic linkages, whilst the modelling of alternative assets is less certain and contains a larger margin of error. Nonetheless, we use the same analytical tools and processes to determine their portfolio applicability.

To derive the expected returns for alternative assets we utilise the expected returns for traditional assets, such as US equities and global bonds, in combination with their historical characteristics[14]. The expected returns for alternative assets are modelled through the historical beta with a traditional asset. This assumes that idiosyncratic factors will persist going forward and provides a framework to capture changes in market risk premiums using asset categories that we have a greater capacity to model.

We note that historical returns and volatilities for freight and Bitcoin are based on spot indices that cannot be implemented. Since the introduction of Bitcoin futures in December 2017, the pricing difference and roll costs have meant investors using the futures to gain exposure received a return 43% lower than the spot index[15]. This is common in markets that experience contango[16]. As such we need to be cautious when looking at historical characteristics, and apply realistic reductions to ensure that the return capture is realistic[17].

12. The historical beta for an alternative asset a (a=1,...,n) and traditional asset t (t=1,...,n) is $\beta_{at} = \rho_{at} (\sigma_a/\sigma_t)$ where ρ_{at} is the correlation of the two returns, and σ_a and σ_t are the respective volatilities.
13. For further information on the Long-Term Asset Return Model see First Sentier Investors. (2013). Strategic Asset Allocation.
14. We use a one-factor regression: $\mu^e_a = \mu^h_a + \beta^h_{a,t} (\mu^e_t - \mu^h_t)$ where subscript a denotes an alternative asset (a=1,...,n), t for a traditional asset (t=1,...,n) while the superscript e denotes expected returns and h for historical returns. The traditional asset t is determined based on having the highest historical correlation with alternative asset a.
15. Bitcoin futures were introduced in December 2017. The Bitcoin futures return is calculated using the Bloomberg futures roll methodology at expiry to minimise the amount of contango in the futures curve, thus maximising the return.
16. Longer-dated futures or forwards have higher prices than the spot index.
17. A reduction in the return of 40% is applied to the spot index for Bitcoin and freight to account for implementation slippage.

Asset classes	Expected return	Expected volatility	Historical return	Historical volatility
US Equities	4.2%	15.7%	13.6%	15.7%
World (ex US) Equities	4.6%	14.9%	5.3%	14.9%
MSCI World Small Cap	4.7%	17.8%	9.5%	17.8%
Emerging Markets Equities	4.7%	16.5%	3.4%	16.5%
Global Bonds	1.8%	3.2%	2.2%	3.2%
US TIPS	0.8%	4.5%	1.7%	4.5%
US High Yield	6.6%	7.5%	3.9%	7.5%
USD Cash	1.3%	0.2%	0.9%	0.2%
Bitcoin	133.0%	1150.2%	294.2%	1150.2%
Freight	43.0%	179.1%	70.3%	179.1%
Timber and Forestry	1.8%	20.8%	6.6%	20.8%
Frontier Equities	3.6%	16.8%	4.1%	16.8%
Distressed opportunities	2.9%	5.8%	4.1%	5.8%
Wine	3.3%	4.6%	2.9%	4.6%
Catastrophe Bonds	5.1%	3.1%	4.8%	3.1%

Source: First Sentier Investors, Bloomberg, Datastream, Internal Proprietary Models.
Past performance is not indicative of future performance.

Portfolio optimisation and implied investment returns

We can also examine how alternatives would fit into an efficient mean-variance portfolio[18] based on having a 60% allocation to growth assets. The portfolio included allocations to Bitcoin, freight, fine wine and catastrophe bonds, all of which have low correlations with equity market risk. The table also displays the corresponding risk weights, which shows each asset class' contribution to the portfolio volatility.

Risk weight distribution – 60% Growth		
Asset classes	Risk weights	Asset weights
US Equities	31.4%	34.4%
World (ex US) Equities	17.2%	20.6%
MSCI World Small Cap	0.0%	0.0%
Emerging Markets Equities	0.0%	0.0%
Global Bonds	0.4%	9.9%
US TIPS	0.0%	0.0%
US High Yield	7.8%	20.1%
USD Cash	0.0%	0.0%
Bitcoin	8.0%	0.3%
Freight	34.8%	4.2%
Timber and Forestry	0.0%	0.0%
Frontier Equities	0.0%	0.0%
Distressed opportunities	0.0%	0.0%
Wine	0.0%	0.5%
Catastrophe Bonds	0.4%	10.0%
Implied Correlation: 0.19		

Source: First Sentier Investors, Internal Proprietary Models as at 30 June 2022.

We can also take a reverse look at the asset allocation and determine the implied investment returns. With some simplifying assumptions[19] we can determine what investors require in expected returns to hold a percentage of their portfolio in an asset category. Having 5% of the portfolio in Bitcoin, for example, funded from the US equities allocation, would imply a return above 450% and a return for US equities of only 2.1%. If the numbers seem too high then the implication is that the allocation to the asset class is also too high. Conversely, if the implied expected returns are too low, it implies that the allocation to the asset class is too low as well.

18. We constrain the maximum asset weight of any single alternative investment to be 10% of the portfolio and the total allocation in alternatives to a maximum of 15%. Please refer to glossary glossary for the definition.
19. Using an assumed Sharpe Ratio of 0.40 and risk-free rate of 0.70%. Please refer to glossary glossary for the definition.

Implied Return Profile – 60% Growth (5% Bitcoin)		
Asset classes	Implied returns	Asset weights
US Equities	2.1%	24.7%
World (ex US) Equities	1.9%	20.6%
MSCI World Small Cap	2.2%	0.0%
Emerging Markets Equities	1.7%	0.0%
Global Bonds	0.8%	9.9%
US TIPS	0.8%	0.0%
US High Yield	1.3%	20.1%
USD Cash	0.7%	0.0%
Bitcoin	452.2%	5.0%
Freight	10.6%	4.2%
Timber and Forestry	1.9%	0.0%
Frontier Equities	2.0%	0.0%
Distressed opportunities	1.2%	0.0%
Wine	0.7%	0.5%
Catastrophe Bonds	0.8%	10.0%
Total Implied Return: 24.4%		

Source: First Sentier Investors, Internal Proprietary Models as at 30 June 2022.
Past performance is not indicative of future performance.

Key findings

We aimed to evaluate two questions:

1. Are alternative investments uncorrelated, low-beta strategies that dampen portfolio volatility and improve risk-adjusted returns?

2. Why consider alternatives given how well equities and bonds have been performing?

So far we have seen that there is a wide variation in the correlation and beta measures of the alternatives examined. Some alternative asset categories have high correlations and a high beta to the traditional growth asset of equities, thus providing little diversification and limited appeal for portfolios.

Asset classes with payoff profiles that differ from traditional assets such as Bitcoin, freight, fine wine and catastrophe bonds may be attractive for possible inclusion in an institutional portfolio, due to their ability to improve risk-adjusted performance outcomes through a combination of return engagement and/or diversification benefits.

The performance of equities and bonds over long periods has been very attractive[20] – equities and bonds have provided positive real returns, and bonds have diversified equity risk during large drawdowns. Going forward, however, with a lower expected return outlook and real bond yields in many countries being negative, buying sovereign fixed income and holding to maturity may result in negative real returns.

This has led investors to search for institutional-quality assets outside the traditional categories. There can be significant early adopter benefits, whereby the first institutions to find attractive investment opportunities should derive the greatest benefits, either in return or portfolio diversification. By the time alternative investments become mainstream, their return characteristics may be commensurate with traditional assets.

Bitcoin case study

There are now more than 20,000 cryptocurrencies worth more than US$1 trillion in circulation[21] and that number is rapidly growing. Bitcoin has become synonymous with cryptocurrency more broadly, being the first successful vehicle. Nonetheless, Bitcoin remains in its infancy compared to the traditional asset classes of shares, bonds, property and gold, and further lacks real-world demand and supply. As such, it remains difficult to draw any strong conclusions, but we explore some of the key areas below.

Cryptocurrencies have displayed significant volatility, they are not backed by a sovereign entity, and their value is not tied to any fundamental source, such as a stream of cash flows. Therefore, their appeal to investors may be due to the perceived lottery preference, possibly in combination with the potential for diversification.

Institutional acceptance of Bitcoin as an asset class is likely to be slowed by regulatory concerns, cybersecurity risks, immature investment and custody infrastructure, and substantial volatility. A further wrinkle is the depth of liquidity and ability to transact.

One of the recent advents for investors that desire exposure to Bitcoin has been the Chicago Mercantile Exchange creating Bitcoin futures in December 2017. These are based on the reference rate calculated from major Bitcoin exchanges. Bitcoin futures experience significant contango, which results in lower returns for investors, likely due to investors' desire to avoid managing security, storage and custody of Bitcoin. The futures contracts are currently the only manner[22] for institutional investors to achieve access to the asset class, although liquidity and volume remain a concern.

20. See First Sentier Investors. (2022). Why Multi-Asset?
21. CoinMarketCap. "Cryptocurrencies." Accessed Jun 30, 2022.
22. In October 2021 the SEC approved ProShares to offer the first Bitcoin futures ETF (BITO). No spot ETFs have been approved by the Securities and Exchange Commission at the time of writing.

"Few assets in financial history have been more fragile than Bitcoin."

Nassim Nicholas Taleb, mathematical, former option trader, and author - Bitcoin, Currencies, and Fragility

Summary and conclusion

The contribution alternatives make to effective and efficient asset allocation should continue to be defined and judged by the asset class's ability to bring positively compounding real return assets that are negatively correlated to traditional asset classes.

In this analysis we have measured a wide variation in the correlation and beta mixes within the different categories of alternatives examined. We have found some alternative asset categories with high correlations and a high beta to the traditional growth asset of equities, thus providing little diversification and limited appeal for portfolios.

We have also acknowledged the changing return profiles of traditional asset classes and the potential for investors to search for institutional-quality assets outside the traditional categories. Separating and identifying the risk and return characteristics of some of the more prominent and easily accessible alternatives categories can provide a basis for investors to explore various frameworks for alternative inclusion in portfolios.

Given the diversity of alternative investment strategies, it is not possible to unequivocally determine whether they may be suitable for a portfolio without a robust understanding of investors' return requirements, investment horizon, risk tolerance and liquidity needs. Nonetheless, it is clear based on the analysis of alternative assets in this paper that adding alternative assets to a portfolio of traditional assets could provide meaningful benefits in overall risk-return portfolio characteristics. We acknowledge these investments have idiosyncratic risks and operational requirements due to their highly bespoke nature and underlying illiquidity. Implementation considerations in achieving and managing an optimal exposure should therefore not be underestimated.

"The road less traveled will not be smooth."

Megan McCafferty, author – Second Helpings

Appendix

Comparing the benefits and disadvantages of liquid and illiquid asset categories

	Benefits	Disadvantages
Illiquid	• Control over the asset • Lower volatility than comparable listed market investments • Potential for higher levels of gearing • Low correlation with equity markets	• Substantial minimum investment requirements • Concentration risk of a single asset or limited number of assets that can be housed in a typical portfolio • Illiquid nature of the investment • Difficulty in determining an appropriate benchmark
Liquid	• Higher liquidity than direct funds/direct investment • Greater accessibility due to the lower minimum investment amount • The ability to easily achieve diversified exposure to different regions, subsectors, etc.	• The relatively high volatility of listed investments • Higher correlation with equity markets

Source: First Sentier Investors.

Historical monthly characteristics

Historical characteristics
113 monthly observations, Feb 2013 - Jun 2022

Asset classes	# months where r < -5%	# months where r < -2.5%	# months where r > 2.5%	# months where r > 5%	minimum monthly return	5% worst monthly return	median monthly return	5% best monthly return	maximum monthly return
US Equities	9	19	38	13	-12.4%	-6.5%	1.9%	7.0%	12.8%
World (ex US) Equities	9	22	38	12	-14.0%	-6.6%	0.8%	6.3%	15.4%
MSCI World Small Cap	11	19	33	15	-20.7%	-7.8%	1.2%	7.0%	15.4%
Emerging Markets Equities	13	31	34	16	-15.4%	-6.8%	0.5%	8.0%	13.3%
Global Bonds		1			-2.7%	-1.5%	0.3%	1.5%	2.3%
US TIPS		3	3		-4.4%	-2.0%	0.3%	2.1%	3.1%
US High Yield	2	6	9		-12.3%	-2.5%	0.4%	3.8%	4.7%
USD Cash					0.0%	0.0%	0.0%	0.2%	0.2%
Bitcoin	40	49	58	54	-40.5%	-30.0%	3.2%	62.8%	451.0%
Freight	42	50	54	49	-59.6%	-34.9%	0.4%	49.3%	97.9%
Timber and Forestry	12	29	38	18	-16.5%	-9.1%	0.9%	9.9%	15.5%
Frontier Equities	11	25	36	13	-21.0%	-7.2%	0.8%	6.1%	14.0%
Distressed opportunities	1	1	3	1	-10.1%	-1.5%	0.4%	2.2%	6.9%
Wine		1	7	1	-3.2%	-1.6%	0.3%	2.6%	5.4%
Catastrophe Bonds	1	1			-6.3%	-0.7%	0.4%	1.3%	1.8%

r = returns
Source: First Sentier Investors, Bloomberg, Datastream. To be consistent across the historical data, we restrict data to the shortest history of the alternative assets, being Bitcoin, which is from 28 February 2013 to 30 Jun 2022.

Data sources			
Name	Description	Data Source	Identifier
Price Inflation US	US CPI, not seasonally adjusted	Refinitiv Datastream	USCP....F
GDP US	GDP US constant prices, seasonally adjusted	Refinitiv Datastream	USGDP...D
US Equities	S&P 500 Composite	Refinitiv Datastream	S&PCOMP(RI)
World (ex US) Equities	MSCI World ex US	Refinitiv Datastream	MSWXUS$(MSRI)
MSCI World Small Cap	MSCI World Small Cap	Refinitiv Datastream	MSSWLD$(RI)
Emerging Markets Equities	MSCI Emerging Markets	Refinitiv Datastream	MSEMKF$(MSRI)
Global Bonds	Bloomberg Global Aggregate Index	Bloomberg	LEGATRUH Index
US TIPS	Bloomberg US Treasury Inflation Linked Securities	Refinitiv Datastream	100+LHGRUST(IN)
US High Yield	CS High Yield Index II	Bloomberg	DLJHVAL Index
USD Cash	Barclays 3 month USD LIBOR	Bloomberg	BXIIU3MC Index
Bitcoin	Bitcoin in USD	Bloomberg	XBTUSD BGNL Curncy
Freight	Baltic Exchange Panamax Index	Refinitiv Datastream	BIFFEXI
Timber and Forestry	S&P Global Timber & Forestry	Refinitiv Datastream	SPGTAF$
Frontier Equities	S&P Frontier Broad Market Index (BMI) ex GCC	Refinitiv Datastream	IFFMFC$(RI)
Distressed opportunities	Credit Suisse Hedge Distressed Index	Refinitiv Datastream	CSTDISH
Wine	Liv-ex Fine Wine 50 Index	Bloomberg	LXFW50 Index
Catastrophe Bonds	Swiss Re Global Catastrophe Bond Index	Bloomberg	SRGLTRR Index

Source: First Sentier Investors.

Glossary

Beta

Beta is a measure of how an asset moves, on average, when the overall market increases or decreases.

Volatility

Volatility refers to the standard deviation of the change in the value of a financial instrument. It is typically used as a metric to quantify risk.

Risk-adjusted returns

Risk-adjusted returns are a ratio that accounts for the level of risk associated with the return. An example of a risk-adjusted return is the Sharpe ratio.

Mean-variance analytical modelling

A mathematical framework for assembling a portfolio of assets such that the expected return is maximised for a given level of risk. The 'mean' refers to returns and 'variance' is used as a proxy for risk.

Open-ended funds

A fund of pooled investor money where units in the fund are created on application and cancelled on redemption. These units are priced based on their net asset value.

Efficient mean-variance portfolio

A portfolio is considered 'efficient' regarding mean-variance when the allocation to each asset maximises the expected return for a given level of risk.

Sharpe ratio

The Sharpe ratio gauges performance by measuring the excess return per unit of risk, characterising how well the portfolio's return compensates its investors for the risk taken. The higher a portfolio's Sharpe ratio, the better its risk-adjusted return. The ratio is calculated as: SR = (Expected portfolio return – Risk-free rate)/ Portfolio standard deviation.